

Minutes of evidence and appendices. Vol. 1, Evidence received in 1901, together with appendices 1 to 15, and index (Being part 2 of the First report of the Commission) / Royal Commission on Arsenical Poisoning arising from the consumption of beer and other articles of food or drink.

Contributors

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ROYAL COMMISSION

ON

ARSENICAL POISONING

ARISING FROM THE CONSUMPTION OF BEER AND OTHER ARTICLES
OF FOOD OR DRINK.

MINUTES OF EVIDENCE AND APPENDICES.

VOL. I.—Evidence received in 1901,

TOGETHER WITH

Appendices 1 to 15, and Index.

(BEING PART II. OF THE FIRST REPORT OF THE COMMISSION).

Presented to both Houses of Parliament by Command of His Majesty.



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1903.

FIRST REPORT—Part II.

MINUTES OF EVIDENCE received by the Royal Commission appointed on 4th February 1901, to ascertain with respect to England and Wales :

(1) The amount of recent exceptional sickness and death attributable to poisoning by arsenic ;

(2) Whether such exceptional sickness and death have been due to arsenic in beer or in other articles of food or drink, and, if so,

(a) to what extent ;

(b) by what ingredients or in what manner the arsenic was conveyed ; and

(c) in what way any such ingredients became arsenicated, and

(3) If it be found that exceptional sickness and death have been due to arsenic in beer or in other articles of food or drink, by what safeguards the introduction of arsenic therein can be prevented,

together with APPENDICES and INDEX.

FIRST REPORT—Part II

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(2) Whether such exceptional sickness and death have been due to arsenic in food or in other articles of food or drink, or in what manner the arsenic was introduced, and

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MINUTES OF EVIDENCE

TAKEN BEFORE THE

ROYAL COMMISSION

ON

ARSENICAL POISONING.

FIRST DAY.

AT WESTMINSTER PALACE HOTEL.

Friday, 22nd February, 1901.

PRESENT :

The Right Hon. LORD KELVIN (in the Chair).

The Right Hon. Sir WILLIAM HART-DYKE.
Sir WILLIAM CHURCH.
Professor THORPE.

Mr. COSMO BONSOR.
Dr. WHITELEGGE.

Dr. BUCHANAN, *Secretary*.

Mr. CHARLES H. TATTERSALL, called; and Examined.

Mr. C. H.
Tattersall.
Feb. 1901.

1. (*Chairman.*) You are Medical Officer of Health of the Borough of Salford?—I am.

2. And I believe you have made special inquiries into the recent epidemic of arsenical poisoning attributed to beer, and have sent to the Commission proofs of a report to the Salford Town Council, which you are making along with Professor Delépine on the subject?—I have.

3. Professor Delépine himself will give evidence at a later period to the Commission. As Medical Officer of Health you are responsible for complying with the regulations and orders of the Local Government Board with regard to your office?—I am.

4. I have received, and other members of the Commission have received, an advance proof of the special report which you have made on the epidemic of arsenical poisoning from beer. Perhaps in giving your evidence you would freely use this report, and give the Commission the benefit of what information you can in that way. Perhaps a few questions may be put to you later on, but I think now, instead of putting questions to you, I would ask you to read such portions of this report as you find it convenient to read, and give any additional information that occurs to you?—I will read the report.

5. You will use your own discretion, and omit certain parts that you may not think it necessary to read?—Quite so. The charts which accompany the report are in the possession of the members of the Commission, I think. (*See Appendices Nos. 1 & 2.*)

6. (*Sir William Church.*) I suppose the charts refer to the Borough of Salford alone?—Yes. The whole of the information has been collected and arises entirely out of the Salford epidemic.

7. These charts apply only to Salford?—Yes, Salford alone.

"From the accompanying charts it will be seen at once that there was a great rise in the number of deaths from 'alcoholism,' 'peripheral neuritis,' or 'multiple neuritis' in the month of June, 1900, and that this continued to increase, reaching its maximum in the month of November. On the 9th of November, Dr. Cran, Poor Law Medical Officer for the Regent Road District, called

and informed me that he had a very large number of cases of peripheral neuritis. His diagnosis had been confirmed by finding that all the sufferers took beer, but he had been surprised to learn that many of the patients had not been excessive drinkers. I obtained samples of beer from public-houses supplied by fourteen different breweries, sent them for analysis, and proceeded to make inquiries into the cases of which Dr. Cran had given me a list. Each case was visited and careful inquiries made from the patients, and the results confirmed by neighbours and others. It was soon ascertained that the sufferers were all beer drinkers, and several of them were employees of a local brewery. Further inquiries into the health of the employees at this brewery showed that during the preceding three months the greater majority of them had been ill, suffering in a similar manner to Dr. Cran's patients. This appeared to point conclusively to the beer from this particular brewery as the cause of the mischief; but further cases were heard of, and these were not traceable to the same brewery, although beer seemed to be the medium through which the illness had been caused in each instance, and in all subsequent inquiries every case investigated proved to be a beer drinker. The amount drank varied very much, viz., from a pint to sixteen pints per diem. The possible cause of the symptoms was considered, and lead poisoning appeared the most probable. An examination of several patients, however, proved the entire absence of the special symptoms of lead poisoning, such as the blue line on the gums, colic, etc. I was well acquainted with the fact that the higher alcohols, especially amyl alcohol, rapidly produce peripheral neuritis, even in small doses, and considering it possible that some degeneration of the yeast might have caused the production of this substance in the process of fermentation, I requested the analyst to examine the samples of beer for it, but at the same time I requested him to make a full investigation into the beer, as there was no doubt as to the fact that it was poisoning people to a most alarming extent. The analyst informing me that he could find nothing in the beer to account for the cases, arrangements were then made with Professor Delépine, on November 16th, for a complete examination of the beer, including physiological experiments should the preliminary examination prove the absence of mineral poisons. This preliminary examination was in progress

Mr. C. H.
Tattersall.
22 Feb. 1901.

Traced to
Beer.

Question
of higher
alcohols.

tory of
demic in
Salford.

Mr. C. H.
Tattersall.

22 Feb. 1901.

Traced to
glucose con-
taminated by
arsenical acid

when, on the 20th of November, we heard of the discovery by Dr. E. S. Reynolds of arsenic in beer, and this observation was at once confirmed. On the 21st, samples of everything used in each of the five breweries situated in Salford were obtained, and on the 22nd a complete set from one brewery was submitted to Professor Delépine, who discovered arsenic in one sample of glucose in large quantities the same evening. On the morning of the 23rd I visited the brewery concerned and obtained the address of the firm which supplied the contaminated glucose (Bostock and Co., Ltd.), and visited their office in Liverpool and their works at Garston, where I obtained a complete set of samples of the raw materials used in the process of manufacture, and the finished products ready for use. On the morning of the 24th arsenic in very large quantities was found in the sulphuric acid, and I visited Messrs. Nicholson and Son, Leeds, who were the acid manufacturers. Here I failed to get any information which could explain the reason for the epidemic commencing in June, but from the evidence afterwards given before the Manchester Coroner it appears that in March Messrs. Nicholson commenced to deliver to Messrs. Bostock a commoner sulphuric acid, which contained arsenic, in place of de-arseniated acid as delivered previously. I ascertained that Messrs. Nicholson manufactured their sulphuric acid entirely from pyrites, and that they used a process to de-arseniate a portion, the remainder being sent out crude. They had supplied Messrs. Bostock for a long period of years, and state that until March, 1900, they invariably sent de-arseniated acid; but at that time they changed their practice and sent the crude acid, which contained large quantities of arsenic. They stated that they had no knowledge of the purpose for which the acid was intended. There are some indications that Bostock's sugar was liable to contamination even before this date, for it is a fact, that there is a marked rise in the deaths from peripheral neuritis from the time that Bostock's sugars were more largely used in the local breweries, i.e., from the latter part of 1896. At the same inquest it was shown that Messrs. Bostock employed a chemist at their works, and a consulting chemist, but neither of these gentlemen systematically examined the sulphuric acid delivered by Messrs. Nicholson. It has been impossible to obtain anything approaching accurate information in respect of the extent of the illness caused by arsenicated beer in Salford. For obvious reasons the public generally have been very reticent and expect their medical attendants to be the same. There can be no doubt, however, that a very great number (probably some thousands) have suffered to a greater or less extent in Salford."

Extent of
Epidemic.

I may add here that almost all the cases that are returned to me in the list are cases among the poorer classes of the population, but that they are not alone the sufferers I know from my own personal knowledge. I know of instances where people in better positions in life have suffered exactly in the same way, although none have come officially to my notice. I have no reason to believe that the cases I know of are the only ones.

3. (Sir Wm. Hart-Dyke.) Do you mean as part of this special outbreak, or previously?—As part of this special outbreak. I am only indicating one of the reasons for thinking that we by no means know of all the cases. There were 996 cases reported from all sources. With regard to 366, I have no particulars as to their sex. Of the balance 281 were males, and 349 females. There can be no doubt that a very great number, probably some thousands, have suffered to a greater or less extent in Salford. I am basing that on the remarks I have just made, and on another statement which I now go on to give from the report.

"One medical practitioner informs me that in August and September he had a great number of cases of herpes zoster, and I know of several instances where persons who were in the habit of drinking some of the incriminated beers, in strict moderation, found in June, July, and August that the beer caused disturbance of the digestive functions, such as vomiting and diarrhoea, and they ceased to take them. So far as I have been able to ascertain there was a marked falling off in the amount of beer consumed in the district about the end of September, two months before the discovery of the poison, showing that many persons must have been affected in a similar way. In one hundred and fifty cases the source of the beer was carefully traced, and it was found that in every instance where one brewery could be connected with the poisoning, that brewery was using Bostock's sugar."

In thirty-seven cases out of 150 it was impossible to connect them with any one brewery. The individuals drank beer in a promiscuous manner. But in the balance we were able to establish the fact that they obtained their beer regularly from one or at most two public houses, although they might have drunk other beer as well. Still, there was one regular supply, and these I have been able to allot to the various breweries concerned.

"The deaths resulting from the special amount of fatality. arsenic contained in Messrs. Bostock's brewing sugars from May to November can only be estimated by comparing the deaths registered from chronic alcoholism, peripheral neuritis, or alcoholic neuritis in the period from June, 1900, to January, 1901, with those from the same causes in previous years, and taking in addition the deaths registered as due to cirrhosis of the liver treated in the same way. Thus, from June 1st, 1900, to January 31st, 1901, there were registered from—

Peripheral Neuritis	- - - -	47 deaths.
Alcoholic Neuritis	- - - -	10 deaths.
Multiple Neuritis	- - - -	2 deaths.
Chronic Alcoholism	- - - -	32 deaths.

or a total of 91 deaths in the eight months, as compared with seven, the average number for the same period in the preceding five years. This leaves a total of 84 deaths which may be considered to be due to the poisoning, in addition to those which were certified as cirrhosis of the liver. In the year 1900 there were 52 deaths registered as due to cirrhosis of the liver, as compared with 30, the average for the preceding five years, which leaves an additional 22 deaths in all probability due to the poisoning, especially considering that the post-mortem examination of the victims showed that even where large amounts of alcohol had not been taken the liver was greatly hypertrophied. There was one death registered from Addison's disease, and I have good reason to believe this was due to the arsenical poisoning. This makes a grand total of 107 deaths in Salford up to the end of January, 1901, probably due to arsenical poisoning from beer, and there can be no doubt that many of the persons still suffering from the effects of the poison will succumb in the near future.

The first chart* shows the number of deaths from peripheral neuritis in each half year from the beginning of 1890 to January, 1901. It will be at once noticed that there is a marked increase in 1897, and it is a somewhat remarkable coincidence that in 1896 Messrs. Bostock became a limited company, and pushed their business much more energetically in this district than formerly. The amount of their sugar used in the local breweries was greatly increased from October, 1896. So far as I have been able to ascertain (quite apart from the change in the sulphuric acid in March, 1900), they have always used an acid made from pyrites which was necessarily liable to contamination; and I feel convinced that there has for the past three years at least been some poisoning by arsenic in beer, although not to an extent to attract any attention. It appears possible that arsenic in association with alcohol is more dangerous than under other conditions, and it is certainly possible, to say the least, that a considerable proportion of the cases which have been looked upon as true 'alcoholic neuritis' have in reality been cases of very chronic arsenical poisoning."

I do not think I need go into the clinical symptoms, except just my own observations at the end.

Turning to page 22 of my report, I go on to say:

"There can be little doubt that the earliest cases did not present the symptoms of poisoning in the same marked degree as the later ones, being little, if any, different to the case of alcoholic peripheral neuritis which have been well known in this district for the past ten years. I examined a considerable number of cases before I saw one which presented all the symptoms which I have classified below, but at the end of November the running of eyes and nose, pigmentation of skin, keratosis, and paralysis were very general. I have tabulated below the results of replies received from medical practitioners respecting the symptoms of 296 cases. These are necessarily incomplete and somewhat unsatisfactory, as in many instances no account of cases had been kept, but as regards their main features they are doubtless fairly correct."

From this it appears that nerve disturbances, sensory and motor, are the marked features of the cases; skin

* Appendix No. 1.

Mr. C.
Tattersall.

22 Feb. 1

Clinical
differences
between
earlier and
later cases

Mr. C. H. Atterall.
Feb. 1901.
of per-
s-attacked

affections, running of the eyes and nose, and pigmentation are also well marked, but gastro-intestinal troubles are not well marked. I call attention to that, because it has been considered—at an rate, I have considered it—one of the prominent symptoms of arsenical poisoning. "In 630 instances I have obtained particulars as to sex, which shows that 281 males and 349 females were affected. The mortality figures show, however, that women are much more liable to succumb to the effects of the poison than men. Thus, out of 115 deaths 28 were males and 87 females. It is impossible to say whether this is due to the females taking more of the poison, or whether their powers of resistance are less. Probably it is a combination of the two reasons." I may say that it is commoner for women to obtain their beer from one source of supply than for men, and that may have something to do with the effects seen.

age
"With regard to age, it is found, as might be expected from the source of the poisoning, that the disease has limited itself to adults. Thus the youngest person attacked, out of 457 cases inquired into, was 19 years of age, and as shown in the accompanying table, the greatest number of cases were among persons from 40 to 50 years of age. It is impossible, with any advantage, to compare the number of persons attacked at the various age-periods with the number of persons living in the borough at those ages, as there can be no doubt that only a portion of the total number of cases has come to our knowledge. In 279 cases I have been able to ascertain the date of the commencement of the illness, as shown in the following table:—

June.	July.	August.	Sept.	October.	Nov.	Dec.
16	24	33	61	69	76	—

From this it will be seen that there was a steadily increasing amount of sickness up to the end of November. In two or three other cases the time of commencement was prior to June, one of these being stated to be four years; but there appears clear evidence that the present outbreak commenced in June and ceased at the end of November. This period corresponds almost exactly with the time during which the brewers were using sugars supplied by Bostocks, manufactured from Nicholson's arsenious B.O.V. acid. "Nicholson's state the change took place in March, and Bostocks that it would be about a month before the sugar would get round to the brewer, and it would be two to three weeks more at least before it could reach the consumer. This brings it to the latter part of May before the affected beer came into circulation, and naturally the symptoms began to develop early in June. It is safe to say that, after the 30th November, none of the contaminated sugar was used by any brewer in Salford. It should be clearly stated that the most careful inquiry in Salford has failed to discover any case of this type of illness, the symptoms of which did not commence prior to the first of December last. For obvious reasons it is exceedingly difficult to obtain anything approaching accurate information as to the amount of beer consumed by any individual, and there is a strong tendency to minimise the quantity in most instances. The information in the following table which represents an analysis of 150 cases, has been carefully sifted, and made as accurate as possible."

Amount of Beer drunk as shown by Analysis of Particulars obtained respecting 150 cases.

Small amount, not exceeding one quart daily	53
Medium amount, not exceeding half-a-gallon daily	44
Large drinkers, exceeding half-a-gallon daily	53

From the table it is shown that 53 persons did not exceed one quart a day, 44 exceeded a quart, but did not exceed half a gallon daily, and 53 exceeded half a gallon daily, in one case going up to 16 pints regularly drunk.

"From this table it would appear that the disease has attacked all classes of drinkers equally, but it must not be forgotten that the small drinkers represent a large proportion of the whole population, whereas the heavy drinkers represent a very small minority. It, however, shows that in about one-third of the cases the sufferers

were very moderate drinkers. Assuming that the beer contained on the average $\frac{1}{4}$ of a grain per gallon, which is, I think, a fair assumption, the amount of arsenic taken in a week by one of the class of small drinkers would be about half a grain, and considering that 1-20th of a grain of arsenic would be a dangerous quantity to take daily for an unlimited period, it is easy to understand that susceptible persons might be poisoned. The second class would take about 1 grain per week, and the third from 2 grains to 4 grains per week. On the 23rd of November, I communicated with the brewers who used contaminated sugar in Salford, and they immediately stopped its use; they sent out no beer which had been brewed with it, and on the 27th they communicated with their customers placing an embargo on all beers until they could be examined by their analysts. On the 29th I issued a circular to all beer retailers in the Borough, as follows:—

"November 29th, 1900.

"It has been ascertained that a great number of persons have of late suffered from poisoning by arsenic, through drinking contaminated beer.

"I have now to inform you that the sale of any such contaminated beer is a serious offence, liable to severe punishment, and that the Food and Drugs Inspector will take samples for analysis without any further warning."

"On December 3rd I commenced taking a large number of samples (under the Food and Drugs Act), all over the borough, with the result that out of 73 samples submitted to analysis the greatest amount of arsenic found in any one was 1-200th grain per gallon, and this beer had not been brewed from Bostock's sugar. Thus it appears safe to say that no beer was sold in Salford with a deleterious amount of arsenic after the 1st of December. Cases continue to occur, and deaths have continued up to the time of writing, and appear likely to continue for some time, but these were found after careful inquiry to be all due to the effects of poison taken before the 1st of December. It must not be forgotten that the effects of chronic arsenical poisoning do not necessarily pass off when the poison is discontinued, and that in a very large number of cases irreparable damage had been done to the tissues and organs, and disease set up which is still running its course to terminate in the death of the patient or his more or less permanent disablement. So far as I have been able to ascertain, over 12,000 barrels of beer (representing 432,000 gallons) were destroyed in Salford."

I come then to the sections of the report which deal with matters with which the Commission are probably better acquainted than myself. It was obviously necessary for me to make inquiries into a number of things, and to obtain samples and submit them to analysis, and in this report a short account has been given of what has been done in that way, and a short statement made, with a summary of information that has been given to me by brewers, maltsters, and others, respecting which I cannot speak with any special knowledge. It is purely information that I have obtained on this occasion.

9. (Chairman.) I think this information would be very valuable to the Commission, taken under the conditions that you describe?—Very good, my lord. "A short indication of the processes adopted in brewing beer will assist in understanding the way in which the arsenic found its way into beer, and so caused the epidemic of poisoning. Brewing is essentially the producing of an alcoholic beverage by subjecting solutions of grape sugars"—I use that term in its colloquial, not its strictly chemical, sense—"to the action of yeast, and flavoured with hops. The form of grape sugar used most largely is malted barley; that is, barley which has been allowed to germinate, the starch of the barley grain being converted naturally into grape sugar. A large quantity of beer is brewed from malt and hops alone, but generally some other form of sugar is used in addition to the malt, or rather, in substitution for a portion of the malt which would otherwise be required. In some instances, raw starchy substances are added to the malt in such quantities that the diastatic ferments in the malt are able to convert them into sugar; in other cases, and more commonly, a manufactured sugar is introduced. This is either 'glucose,' a substance which is prepared from starches such as maize flour, sago, tapioca, etc., by the action of sulphuric acid; or 'inverted sugar,' which is prepared by treating cane sugars with sulphuric acid. There are many trade names for substances used, but they all fall under one or other of these headings. I

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Action of M.O.H., and local authority.

Destruction of beer by brewers.

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am informed that, to make 400 parts of beer the brewer takes 100 parts of solid material (75 per cent. at least of malt and from 6 to 25 per cent. of substitutes) and adds 300 parts of water. This is mixed in the mash tun, and the resulting wort or mixture is boiled together with the sugar and hops in a copper vessel; the boiling fluid is then filtered through the exhausted hops and cooled, yeast is added, and fermentation takes place. The yeast is afterwards removed, and the beer run off into barrels. Various other substances are used in the brewery, in addition to glucose, malt, hops, and grain. In summer, it is said to be desirable to add some substance to prevent the beer turning sour, and various forms of preservatives are used, which appear to be largely sulphites. 'Priming' is added to the barrels of the cheaper beers by some brewers; this is usually a limited quantity of inverted sugar. Then 'finings' are added to the barrel by the beer retailer. The only specimen of 'finings' I obtained was isinglass. Thus two substances, malt and sugar (glucose or inverted sugar), are used in considerable quantity, and a number of others, yeast, hops, preservative, priming, and finings in small quantities. I believe hop substitutes are also occasionally used, but I do not find any in the five breweries examined. Consequently the two substances which above all others should be kept pure are malt and sugar, since small amounts of impurity in the others would not affect the beer to any material extent. The analysis of the sulphuric acid obtained from Messrs. Bostock's works showed that apart from the precipitate it contained at least 1.45 per cent. of white arsenic."

Arsenic in
Nicholson's
acid,

10. (Chairman.) Apart from the precipitate, what happened?—The sample of acid we obtained, on standing, deposited a considerable precipitate.

11. Without any treatment?—The acid, without any treatment.

12. It showed a precipitate?—It did, and that precipitate is very largely, if not almost entirely, arsenious acid; but Professor Delépine will deal with this question from the scientific point of view. The fluid, apart from the precipitate, contained this very large proportion of arsenious acid, 1.45 per cent.

13. (Professor Thorpe.) Is it not a fact that the precipitate might largely consist of sulphate of lead?—It did not. That was what we thought it was when we filtered off the precipitate and examined the sulphuric acid in the first instance. We did not think we were taking the arsenic out to any extent, and thought it was probably sulphate of lead, but further examination has shown that it is not sulphate of lead, but practically almost pure arsenious acid—white arsenic.

14. (Chairman.) We shall hear from Professor Delépine perhaps, but did the precipitate contain nearly pure arsenious acid? Perhaps it contained more arsenic than that which was left in the solution?—That is the reason why I give the analysis here of Dr. Campbell Brown, of Liverpool, and Mr. T. A. Reid, of Liverpool, as given in their evidence before the coroners. They found that the total percentage of arsenic in the sulphuric acid was at least 2 per cent., rising in one sample to 2.6 per cent.

and in Bostock glucose.

15. Per cent. by weight?—Yes, per cent. by weight. I go on to say in my report: "This would more than account for the largest amount found in Messrs. Bostock's glucose, namely, .095 per cent., and this again would account for at least 2 grains per gallon in the beer. As a matter of fact, 1.5 grains per gallon is the highest amount found in the beer." I might refer here to the table of analysis. (See Appendix No. 12.) Table I has been worked out to show the amount in grains per gallon approximately of what arsenic is in these samples of beer. All those marked with a star were beers brewed more or less from Bostock's sugar, and it will be seen that the amounts vary very much, from 1.30th to 1½ grains per gallon.

16. (Professor Thorpe.) Are these Professor Delépine's observations?—They are.

17. This is marked as "private." Does that mean a private brewery?—Yes.

18. Was it not for sale?—Private is meant to indicate there that it was not a sample I took officially, but a sample that reached us in another way.

19. Was it beer for sale?—It was beer for sale, only it did not come from Salford, but from another district. That is really the explanation. These are Professor Delépine's tables (see Appendix No. 12.), and he will explain the source of the sample when he is before you. "The cause of so much variation in the amount of arsenic appearing in

the beer is—first that there can be no doubt the acid itself varies greatly from this point of view. Then the amount of arsenic removed from the glucose by the charcoal filters will vary very much; and again, the amount of glucose used by different brewers is a very variable quantity. Some brewers mixed the Bostock with other sugars, and so again reduced the amount in the beer. In beers not brewed with Bostock sugar the highest amount has been 1.28th grain per gallon, and this was brewed in a brewery where Bostock sugar had previously been used. I should not be prepared to say that it is quite safe to drink beer which contains 1.100th grain or more of arsenic per gallon. A full medicinal dose of arsenic is 1.12th grain, and that is rarely given even under the constant supervision of medical men. The more usual medicinal dose would be from 1.20th to 1.50th grain of arsenic." I may say that I myself have seen symptoms of arsenical poisoning, vomiting, and diarrhoea resulting from an odd dose of 1.50th of a grain.

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Variation
quantity
arsenic in
impurities
beers.

20. (Chairman.) From one single dose?—From one single dose. That was in a patient who was very peculiarly susceptible to arsenic, and it was tried for a number of years several times over, always with the same result. I state this simply to indicate that to some individuals an extremely small amount of arsenic is a dangerous thing.

Individuals
susceptible
to arsenic

"As the beer brewed from Bostock sugar contained on the average 1.32nd of a grain of arsenic per pint, it is at once seen that the phenomena of poisoning are accounted for, and from the fact that the amount may have been 3.16ths grain per pint it can be understood that, as appears to have frequently happened, an odd pint of the contaminated beer has been sufficient to produce very unpleasant symptoms in individuals. Instances where this occurred have been authentically described to me. Glucose is prepared from various starches by the action of sulphuric acid and heat. Maize, sago, tapioca, wheat, and rice flour are all used for this purpose. The flour is thoroughly mixed with water, and sulphuric acid added to the extent of about 6 per cent. The mixture is boiled for about two hours and then run off. Whiting is added to the liquid, and this neutralises any acid not used up in the process of converting the starch into grape sugar. The mixture is then pressed through canvas bags which remove all suspended matter, and is filtered through animal charcoal, in some cases several times. The clear liquid is treated with sulphurous acid, for the purpose of bleaching it, and is placed in pans and concentrated to a point at which when cooled it will become a solid substance. Inverted sugar is prepared in a manner exactly similar to glucose, except that cane sugar is used instead of starch, and the sulphuric acid is added in smaller quantity, 2 to 4 per cent., instead of 6 per cent. as in the glucose. It is also not heated to so high a temperature, inversion being carried on at 160 deg. Fahrenheit. In each instance the resulting product is a perfectly harmless and satisfactory form of grape sugar, provided that pure materials are originally used, and it is found in practice that the filtering processes take out undesirable substances. Thus traces of arsenic are taken out in the charcoal filters. An examination of the charcoal used by Messrs. Bostock showed that the charcoal from the used filters (it should be used once only and then reburnt) contained large quantities of arsenic, whereas the reburnt charcoal from the same filters contained smaller quantities of that substance. Glucose is used for a number of purposes, namely:—malt substitute in brewing, in the preparation of leather, by jam makers (especially makers of whole fruit jams, which fetch the highest prices), in confectionery, and in the preparation of the clear breakfast syrups, which in many cases are almost entirely glucose. The samples which I have seen of glucose used in the three latter processes were much clearer than for the two first, being an almost transparent colourless fluid. It is thus evident that arsenic present in the sulphuric acid used would contaminate the resulting sugars, and it is the practice for glucose manufacturers to use either sulphuric acid guaranteed free from arsenic, or acid manufactured from native Sicilian sulphur only. It would appear desirable that in the future the only sulphuric acid used in the preparation of food stuffs should be that manufactured from native Sicilian sulphur, as it is obvious that a mistake in the labelling or delivery of a carboy from a works manufacturing pyrites acid might have very serious results, and accidents of this kind can be best guarded against by prohibiting the use of any pyrites acid for such purposes. The manufacture of sulphuric

Manufacture
of glucose

Arsenic in
charcoal
filters.

Acid from
Sicilian
stone should
be used for
food purposes

H. acid is a much better known process than that of glucose and invert sugar, and there is no need for me to refer to it further than to point out the difference in the source of the sulphur which is used. The purest acid is made from native Sicilian brimstone. This alone should be used whenever the ultimate destination of the manufactured product is human consumption, and as sulphuric acid is used in the preparation of many articles, or in cleansing vessels, etc., it should be widely made known that native Sicilian brimstone acid should be required in all such cases. So-called brimstone acid is also prepared from recovered sulphur from alkali works and from spent oxide from gas works. It is most largely prepared from pyrites. One witness at the coroner's inquiry into this matter stated that 98 per cent. of all sulphuric acid made was produced from this source."

21. Is that called brimstone acid?—It was said so at the inquest. It was said that de-arsenicated sulphuric acid is sold on the market as brimstone acid. That was the evidence of one witness I think.

22. (Professor Thorpe.) Were you present at the inquest, and did you hear that statement?—I was, and did.

23. Was the statement made that it was brimstone acid or merely stone acid?—Stone acid was stated to be the common term used, stone acid being, according to the evidence of the witness, equivalent to brimstone acid—a shortened form of brimstone acid.

24. Was the fact elicited in the course of the coroner's inquiry that the workpeople are in the habit of calling pyrites stone?—No, that was not.

25. (Sir William Hart-Dyke.) You mean that the witness wished it to be inferred that "stone" was really an abbreviation for "brimstone"?—That was so.

26. (Chairman.) There might have been an ambiguity. Some witnesses might have imagined the common use of the word "stone" was in respect of pyrites acid?—It might have been, only it was not mentioned at the inquest that it was. It seems a probable thing. Then I go on in the report:—

"With regard to arsenic the first quality (i.e. Sicilian brimstone acid) is practically pure. The second should not be contaminated, but is not so safe as the first. The third, unless treated specially to remove arsenic, always contains that substance, and in any case the acid from pyrites should not be used in the preparation of any articles for food, as even if de-arsenated acid be used, a mistake at the acid works might have the most serious consequences. The amount of arsenic in the samples of sulphuric acid from Messrs. Bostock's works and supplied by Messrs. Nicholson varied from 1.4 to 2.6 per cent. by weight of arsenious acid. As Messrs. Nicholson were delivering to Bostock's seven to ten tons of this acid weekly for a period of eight months, from four to six tons of white arsenic were used in the preparation of this glucose and invert sugar during that period, and it is not surprising that the effects have been so disastrous. A further result of this investigation has been the discovery that arsenic is in small quantity frequently present in beer apart from the use of contaminated sugar. The amount is very variable, ranging from five parts in 10,000,000 to the slightest traces. The possibility that occasionally the amount may greatly exceed the largest quantity found in the course of the inquiries cannot be ignored, and it was obviously important to discover the source of the contamination. In malt variable quantities of arsenic were found, and it was also observed that the quantity varied in different samples from the same malting. The large quantity of malt used in brewing makes any impurity a very serious matter, and inquiries were made to discover the source of the contamination. I visited several malt kilns and various samples were submitted to analysis, and it was proved that practically all the arsenic was introduced in the process of kilning and the amount varied with the fuel used. Thus in malt dried with gas coke fires arsenic was found in considerable quantity, reaching 1.80th grain per pound, which might produce as much as 1.32nd grain of arsenic per gallon of beer when used in brewing." That is, provided all the arsenic got through into the beer, which is an impossibility in actual practice, because the arsenic contained in the original ingredients does not all get through into the beer. Some is taken up by the yeast, some is deposited on the copper and the vessel and some is probably thrown down in the course

of the precipitation of the albumoses in the cooling of the wort in brewing.

"In those dried with washed smelting coke the quantity was less, and in those dried with anthracite coal the quantity was least. Some malts were found practically free, and these it was discovered had gone through another process after kilning, viz., brushing and polishing, which appeared to remove the impurities from the surface of the malted grain, where it is deposited from the furnaces in process of kilning. It is interesting to note that the samples most free from arsenic were dried on kilns constructed on the double floor principle. Some roasted malts were also found quite pure, and these had been roasted in drums after being dried in the usual kilns, the polishing in the heated drums apparently removing any arsenic. From these results it would appear that it is very desirable that anthracite coal alone should be used for kilning malt, and that the malt should invariably be brushed and polished before grinding for the mash-tub. It would also appear that if malt could be dried in drums without any contact with the fumes from the fuel without losing its flavour, it would be the most satisfactory method. Six samples of barley were examined, and three proved to contain traces of arsenic. It was ascertained on further inquiry that two of these had been kiln dried, so that only four samples of pure barley were analysed, and one contained a slight trace of arsenic. There is not the slightest danger of beer being contaminated from the barley itself, as in the process of malting and brewing the slight trace present in the grain would be so diluted as to become unrecognisable if even it was not lost in the process. Twenty samples of hops have been examined, and although small quantities of arsenic have been found in many of the samples, the quantity, taking into consideration the amount of hops used in brewing, could not possibly cause any injury through the beer. Arsenic when present is probably due to the same cause as in malt, that is, the use of impure fuel in kilning, or the use of impure sulphur on the fires. It is difficult to conceive that contamination could be conveyed to beer through the medium of yeast. The yeast appears to have some power of taking up arsenic, but its influence would probably have the direction of diminishing the amount in the beer and not increasing it."

27. Might not yeast that had been used from a previous brewing carry with it the arsenic?—That opens a question that is being investigated at the present moment by Professor Delépine. Although it appeared in the first instance that the addition of a quantity of yeast which increases largely in the process of brewing—the quantity added to the wort grows to a very great extent in the process of brewing—at the end of the time the whole of that yeast is found to contain arsenic if arsenious yeast be used; but still I believe Professor Delépine has found that strongly contaminated arsenious yeast will give a little arsenic to beer which otherwise would be pure. That is the outcome of experiments which he is at present completing.

28. (Professor Thorpe.) Do you know in what form the arsenic is in the yeast?—I do not. I go on to say:

"The analysis of certain samples given in Professor Delépine's report shows that the possibility of contamination with arsenic from these substances cannot be disregarded, and they should be carefully watched. The use of preservatives opens up the further question of the possibility of the use of substances which might be dangerous in other ways, but it must not be forgotten that they are only used in very small quantities. My conclusions are: (1) It may be considered proved by the clinical symptoms, the presence of arsenic in the urine of patients, and in the body of patients who died, that the cause of this outbreak of epidemic disease was poisoning by arsenic."

Dr. Dixon Mann and Dr. Stevenson found it in the body. We report here an analysis by Professor Delépine of a sample of urine containing a large quantity of arsenic:

"(2) That the arsenic was due to the drinking of beer in the preparation of which sugar from Messrs. Bostock and Co. was used, and that this sugar was prepared from exceedingly contaminated sulphuric acid supplied by Messrs. Nicholson, of Leeds. It may be stated clearly that if beer had been brewed from malt and hops alone no serious damage from poisoning with arsenic could have occurred, although malt more or less impure might have been used by the brewer; and in the light of the results of this investigation it may be considered equally certain that there is no reason why beer brewed from malt and hops should under any circumstances contain more than $\frac{1}{100}$ grain per gallon, as the use of anthracite

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derived from the fuel on the kiln.

Arsenic in yeast.

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Recommendations.

All poisonous chemical substances should be labelled.

Food and Drugs Act should apply to poisons in food, whether of seller or not.

Public Health Authorities, through M.O.H., ought to be informed of outbreaks of non-notifiable illness.

Provision needed for continuous scientific investigation of food-stuffs.

fuel in the preparation of malt and subsequent brushing and polishing gave a practically pure article. Again, it is quite clear that glucose and invert sugar as usually prepared are absolutely innocuous substances, and considering the fact that chemical science is progressing so rapidly in the direction of replacing natural products with manufactured articles, it would appear unreasonable to forbid the use of these substances, provided that some means may be devised by which carelessness of one or more individuals can be prevented from endangering the lives and health of the public. At the same time it should be recognised that any person replacing a natural substance by a manufactured article in the preparation of any food stuffs, takes upon himself the responsibility of seeing that no injury shall ever result from such substitution. This naturally applies to many things in addition to beer. The only method of prevention is to go to the fountain head and deal with the chemical manufacturer, as many articles are prepared for food by small and ignorant tradespeople who might use dangerous substances without any knowledge of the danger. I would suggest that chemical manufacturers be compelled by law to label every article whether apparently meant for use in the preparation of food stuffs or not, which contains any known poison, with a statement that such poison (naming it) is present. This could only be properly carried out under the supervision of inspectors under the Central Government. The Foods and Drugs Act should also be amended so as to make the contamination of food stuffs with poisonous matter in appreciable quantity, whether to a dangerous extent or not, and whether to the knowledge of the seller or not, an offence within the meaning of the Act, as it is obvious that the presence of a poison in a small quantity is often an indication that there is distinct danger of a dangerous quantity being introduced at any time."

I pause there to add that the seller can always and ought always to protect himself by obtaining a warranty from the person from whom he obtains the substance he sells.

"Sulphuric acid made from native Sicilian sulphur should alone be used in any process which might affect food. This investigation has shown the great importance of some improvement being made in the arrangements for the notification to the health authorities of outbreaks of disease. Certain specified infectious diseases are notified under the Infectious Diseases Notification Act, but it should be recognised by the medical profession that the public have provided an organisation for the express purpose of dealing with outbreaks of disease, and notification of any disease of an unusual character should take place, as a matter of course. In this instance a large number of people were killed and a vast number were more or less seriously affected from the beginning of June, the number increasing steadily up to the end of November in Manchester, Liverpool, Salford, and many other towns, but it never seems to have occurred to anyone that it was worth while to put the machinery of an official inquiry into the cause of all this unusual sickness into motion, until Dr. Cran, of Regent Road, Salford, called upon me on the 9th of November; and I very much doubt if the other medical officers of health received any intimation until the press published Dr. Reynold's discovery. I find that there is an order of the Local Government Board issued in 1879 requiring lists of cases of new sickness treated by the Poor Law Medical Officers, to be sent regularly to the Medical Officer of Health. I do not know whether this order has ever been recalled but it has certainly fallen in desuetude. If still in force it should certainly be carried out, and it would be advantageous if the Local Government Board would regulate the fees to the Clerk to the Union which can be paid under it. This inquiry has shown that there is urgent need for some provision whereby regular scientific investigation—chemical and physiological—into the constitution of food stuffs and their adulterants, can be carried on continuously. This would tend to prevent similar calamities to the one from which we have suffered, and at the same time provide a readily accessible staff of trained observers to deal with such emergencies should they arise. In the present instance but for the exceptional kindness of Professor Delépine it would have been impossible to have traced and checked with reasonable promptitude this extensive poisoning in Salford."

29. (Chairman.) Can you tell the Commission the population of Salford?—223,418.

30. Referring to a statement on page 25, you say: "It should be clearly stated that the most careful inquiry in Salford has failed to discover any case of this type

of illness, the symptoms of which did not commence prior to the 1st December last." What steps have been taken to inquire into cases of illness after December 1st? I put this question in order that the Commission may be satisfied that the epidemic then came completely to an end in Salford?—Immediately after the beginning of December I sent out forms to every medical practitioner in Salford asking for particulars of any cases that he could give to me. I received lists from a large number, and subsequently, early in January, I sent again and inquired from these gentlemen as to any further cases that had come to their knowledge. I received them also from the Poor Law authorities and from the hospitals. The result was that in January I heard of 39 cases that had arisen and were not included in the original list. These 39 cases were inquired into, and in every instance the illness was found to have commenced before the 1st December, the illness in some cases going back to the middle of the summer.

31. Then there was a statement on page 32 of your report, where you say: "Glucose is used for a number of purposes, namely, malt substitute in brewing, in the preparation of leather, by jam makers (especially makers of whole fruit jams, which fetch the highest prices), in confectionery, and in the preparation of the clear breakfast syrups, which in many cases are almost entirely glucose." As medical officer of health, have you any knowledge of any cases of illness resulting from any of these substances, confectioneries, jams, or syrups?—I have not. Samples of these substances have been analysed, but with entirely negative results.

32. (Professor Thorpe.) Were those samples of English manufacture or of foreign manufacture?—I cannot say. They were samples bought in the ordinary way in the shops.

33. (Chairman.) How many samples of such jams or syrups have been investigated?—The number is not large. I could not say exactly; I should think not more than ten samples in all.

34. There is a question which perhaps I should not put to you, but if you can answer it, well and good, but if not, never mind. Have you any means of knowing whether Bostock's sugar was used for any other of these food stuffs, or was it solely sent out to brewers?—It was stated in evidence more than once in the Coroner's inquiries that Bostock's invert sugar and glucose were supplied to no one but brewers. I obtained that information in the first instance on my first visit to Bostock's works.

35. Also I wish to ask a question in respect of Nicholson's. The information you have had from Nicholson you refer to on page 7, where you say you had failed to get any information which could explain the reason for the epidemic commencing in June. Was there any reticence on the part of Nicholson in answering questions?—I explained the position to Messrs. Nicholson, explaining that an epidemic of arsenical poisoning had broken out, of which commenced in June, and that it had been traced to Bostock's sugar, and through Bostock's sugar to their acid, and I asked them if, since the beginning of January, they had made any change, or what changes they had made in the sources of their pyrites.

36. Since the beginning of January last year?—Yes, 1900. I asked if they had made any change in the source of their pyrites used in the manufacture of the sulphuric acid, or if they had made any change in the sulphuric acid. They told me there had been no change.

37. It was only from the evidence given before the Manchester Coroner that you are able to make the statement which appears regarding the change in the acid?—That is so. Up to that time it was a very difficult and unexplainable problem as to why the epidemic should have begun in June, but the coroner's inquiry cleared it up. I should explain that I think it is due to Messrs. Nicholson to say that when I saw them it was on a Saturday afternoon, and their works were closed. I saw the partners, and they said so far as they could remember—that was the way they put it—there had been no change made either in the sources of their sulphuric acid or in the deliveries to Messrs. Bostock. That is what they told me at that time.

38. It would not, therefore, be fair to consider that there was any wilful reticence?—I do not think it would be fair to think so.

39. The evidence that they gave before the Coroner then contains the information on which this is founded?—It does.

Mr. Tattersall.
22 Feb.
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H. 40. I just wished to know that, and to have our minds
disabused of the idea that there was any wilful reticence on their part?—I should not like to say there was.

901 41. Referring to page 31, and the table, I see that you refer to the beer brewed from Bostock's sugar containing on the average 1-32nd of a grain of arsenic per pint. Casting one's eye over the numbers in the table giving the quantities per gallon, there being 8 pints in a gallon, one-eighth part of the numbers in Table I. would show the numbers on which the average 1-32nd is founded?—Not quite, because, for instance, some of the more contaminated beers are beers that are sold most largely in the borough, and that statement of 1-32nd cannot be said to be a scientific average at all. It is simply a rough average from a general consideration of all the conditions.

42. And to form a correct average, of course, one would need to weigh the figures given in Table I with factors depending on the quantities of the particular samples that were produced and consumed?—Yes.

43. A factor for the quantity would need to be multiplied into the numbers here before taking an average?—It would.

44. I wish to be clear on that point. We may think of 1-32nd of a grain of arsenic per pint as being an approximate average?—Yes, that is so; it does not profess to be anything more than approximate. I am personally of opinion that it is putting it at a minimum. Some of the beers have certainly been much more contaminated than others. The beers from the same brewery vary at different times, and I believe that if we had had more beer to go on, we could have done better. The difficulty is that all the beer has gone as far as we are concerned. We have not been able to obtain any of the beer since the beginning of December, and our inquiry into it has been limited somewhat in that way. But I believe more would have been found if we could have had more beer to work on. That is simply an opinion—it is not worth much.

45. It is certain that in many cases the quantity was more than 1-32nd of a grain per pint?—It is.

46. (Sir William Hart-Dyke.) You, of course, wish the Commission to understand, so far as this large and sudden mortality was concerned, that the cause was clearly defined by the limit which you give of December 1st?—I do.

47. And after the various investigations into the subject, and the alarm that was caused, and the large district which was supplied with this drinking material, you can point to December 1st as a date which indicates clearly no doubt as to what the special mortality came from at that period?—That is so.

48. You point rather, do you not, on page 12 of your report, to the possibility that for many years past, or for a considerable period, the type of disease which has been called alcoholic neuritis may have been miscalculated by medical men, and it may be possibly that it proceeded from other causes, that is to say, from the presence of arsenic in the beer?—I think that for this reason: that when this particular attack, which I think is clearly traceable to one particular lot of arsenic contained in one particular substance—which is arsenic per se—when this occurred, the medical practitioners did not recognise it, and they did not recognise it for the simple reason that it was practically the same thing they had been treating before which had gone by another name.

49. (Chairman.) What called their attention to it was the great increase in such illnesses?—Quite so.

50. There was an abnormal increase?—Yes. It ran for five months before anyone thought of investigating it.

51. (Sir William Hart-Dyke.) You said further on in the report that there could be no doubt that only a portion of the total number of cases came to your knowledge or to the knowledge of medical men?—I mean that to my knowledge.

52. I suppose you have been medical officer for some years?—For three years.

53. And you have an intimate knowledge of the district?—Yes.

54. And you know a great deal also of the habits of the people?—Yes.

55. Have you any notion as to what proportion of cases have probably escaped altogether?—I have not. It is a problem on which I have thought a great deal, but I can see no way of getting at any information that

would be valuable. The strongest indication that there has been a great amount of illness beyond what we know of is in the great dropping off in the amount of beer drinking. It became a joke in the workshops in the borough when men fell ill that they had been drinking beer.

56. (Chairman.) There was evidence of that before November or December?—This was two months at least before I had any knowledge that there was any special illness.

57. The workmen themselves had found there was something wrong with the beer?—Yes.

58. Did they drink other beer, or give up drinking beer?—They drank whisky, I think.

59. (Sir William Hart-Dyke.) But previously to that is it not possible that in very many cases, where a person may have felt he had drunk more than he ought to have drunk, he may have attributed any illness he suffered from to excess, and therefore have been rather averse to approaching a medical man?—As I say, I heard of no cases except amongst the poorer classes of the population. I do know that members of other classes have suffered, and I am quite confident that the few cases I know of are by no means isolated ones. But at the same time people in that position in life would not themselves give any information, and would be strongly averse to their medical men giving any information with respect to their illnesses.

60. You refer a little later to the question of brewing from malt only, and you very rightly say that the large quantity used makes any impurity in it a very serious matter. I suppose you have never had the least suspicion of the possibility of malt containing arsenic?—I have not. When this inquiry began, I may say that the possibility of the presence of arsenic in beer never occurred to my mind in the first instance, although it is referred to in Dr. Wynter Blyth's book, and there are researches by Clouet and others. Still it was not a recognised thing.

61. (Professor Thorpe.) Dr. Wynter Blyth's book makes no reference to beer, does it?—No. It makes reference to glucose, and of course knowing that glucose was used in beer; it is not in the article on beer in Dr. Wynter Blyth's book, to which I referred, but in the article on glucose; had I seen that reference I should have probably suspected arsenic earlier. As I did not, and I had never heard of arsenic being in beer, I did not think of it.

62. (Sir William Hart-Dyke.) You state clearly in your report that if beer had been brewed from malt and hops alone, no serious damage from poisoning with arsenic could have occurred?—That is my distinct opinion.

63. And you also say that under no circumstances could beer brewed from malt and hops alone contain more than $\frac{1}{100}$ grain per gallon?—That is provided certain things are done.

64. One being the use of anthracite fuel in the preparation of malt and subsequent brushing and polishing?—If proper means are taken to make the malt free from arsenic, there is no reason why any beer should contain more. We did not find in any beer brewed from malt of that description more than $\frac{1}{100}$ grain per gallon.

65. And you think that complete security can be obtained by a very simple process?—I do.

66. You think in fact that with the commonest care on the part of the brewers the consumer would have complete security?—I do.

67. (Sir William Church.) When did you first use in the Register of Deaths alcoholic neuritis and peripheral neuritis?—I should not expect to find deaths attributed to it earlier than 1886, but from 1886 onwards it became generally known to the medical practitioner that peripheral neuritis was often alcoholic.

68. It would be 1885 or 1886—I would not be certain of the year—that it first appeared in the nomenclature of disease?—That is so.

69. Then for a considerable number of years few deaths would have been probably registered under that term?—That is so.

70. So that it is quite possible there might have been more deaths in 1890 and 1891 from that cause than appears in this table?—I am inclined, as far as an opinion is worth anything, to think that that small rise shown in 1893 may be considered to correspond with

Mr. C. H. Tattersall

22 Feb. 1901.

Beer drinking diminishing before cause of outbreak discovered.

Former knowledge of liability of glucose to be arsenical.

Risk from arsenic much less in all-malt beer than in beer brewed from glucose.

Alcoholic and peripheral neuritis.

Mr. C. H. Tottersall. the rise in final knowledge on the part of the profession in the use of that term.

22 Feb. 1901. 71. And you think that by 1897 that form of disease, leading on to death, was fairly generally recognised by the profession in Salford?—Certainly, in our neighbourhood.

(Chairman.) Alcoholic neuritis is what you speak of?

(Sir William Church.) Yes.

long been associated with beer and not spirits. 72. (Chairman.) Has that been connected with the use of spirits, whisky, or gin, or brandy, or only with the use of beer?—It has been considered generally that alcoholic neuritis was more likely to be produced by spirits than by beer; but our local experience in Manchester all through—and I may say that this subject was worked out in Manchester by the late Dr. Ross and Dr. Dreschfield—led me to believe that beer drinkers have been the predominant factor in the returns of alcoholic neuritis. But it is produced by spirits, and believed to be more produced by spirits than by beer.

73. (Sir William Church.) Has it not been found, since the form of disease has been recognised, that it is generally more fatal in women than in men?—That is the case, I believe.

Incidence on sex, 74. And men drink more beer, do they not, than women?—They do. They drink more spirits also. I say they do, but I mean they are believed to do so. My own impression, from the habits of the population that I have studied locally, and it is an impression which it is impossible to adduce positive facts to prove, is that the heavy drinker, the drunkard, certainly, takes a larger quantity of alcohol than women drinkers; but the average moderate-drinking man does not take as much as the average woman drinker, who sits at home and sends round the corner for a jug of beer twice or three times in the course of the day. She certainly takes more than is generally believed. That is my opinion.

75. But you have no reason for thinking that women are more apt to suffer from ordinary arsenical poisoning than men?—I have no reason to think so. These figures would seem to show that men suffered nearly as often as women, only they did not die. The mortality was much more severe among the women. I refer to the figures at page 24.

PARTICULARS as to Age and Sex obtained respecting 457 Cases.

	Females.	Males.
0-20	5	—
20-25	4	2
25-30	32	6
30-35	23	21
35-40	39	37
40-45	34	67
45-50	41	45
50-55	20	21
55-60	11	21
Over 60	15	13
	224	233

76. The numbers affected are much the same, 224 and 233?—Yes.

77. But you will see among the deaths in the paragraph above that out of 115 deaths 28 were males and 87 females?—Yes.

78. (Dr. Whitledge.) The cases on page 24 are selected, are they not, because they do not mount up to the total of 996?—That is so. They are cases taken at haphazard.

79. Page 8, where you give the analysis, shows a very heavy incidence upon females?—Yes, but there again you see a large portion of the total of the 996 have no particulars against them. In 366 cases no particulars are stated.

Explanations of Messrs. Nicholson. 80. (Sir William Church.) Messrs. Nicholson, in fact, said that they did not change in any way the source of their pyrites?—That is what they told me. They told me that their office was closed, and they could not get at their books, and they could give me no definite information. But that was their impression at that time. What their exact information is now I cannot say. They stated they were Spanish pyrites that they used, but they did not give me the name of the mine.

81. On page 29 you say that various other substances are used in a brewery. I suppose you mean rather in brewing than in the brewery?—Yes, in brewing.

82. In addition to glucose you mention malt, hops, and grain. At the foot of that you refer to the antiseptic used in the finings of the beer?—I am referring really to what follows in the other paragraphs, the antiseptics, the finings, and the hop substitutes.

83. (Mr. Cosmo Benson.) Just on that question of brewing I wish to ask a question. You gave Sir William all Hart-Dyke just now the impression that if beer was brewed entirely from malt and hops it would not contain more than a certain amount of arsenic, and you mentioned that you had analysed a certain number of samples. I presume you have the declaration that it was brewed from malt and hops only from the brewer?—Only from the brewer.

84. There is no means of analysis?—No.

85. There is no means by which you can tell whether the finished beer is brewed from malt alone, or from malt mixed with glucose?—No. There was a prosecution in Nottingham where the analyst stated that some glucose had been used in the beer, but I do not know the process by which he would tell that glucose was present in the beer.

86. Not after fermentation?—I do not know.

87. Not if it was brewed, certainly not. It might be if it had not been fermented, but I do not think there is any process?—I do not know of one.

88. I think the disease is very much of the same character as comes from lead poisoning?—All the metallic poisonings have similar characteristics.

89. So far as you know, there was no trace of lead poisoning in any of these beers?—They were all examined for it.

90. And you satisfied yourself practically that it was arsenic?—Decidedly; I satisfied myself it was not lead in the first instance, because lead was the first thing I thought of as soon as I heard of the cases.

91. (Sir William Church.) Lead poisoning is easily recognised?—Yes, it has certain characteristics.

92. It is very easily recognised by a medical man by certain definite signs?—Yes.

93. (Professor Thorpe.) Would you kindly tell the Commission why you know that the higher alcohols, especially amyl alcohol, produce peripheral neuritis?—I also know of it because of a series of experiments carried on in the Owens College laboratories some years ago, under Professor Delépine's supervision. He experimented for a considerable period of time on the feeding of animals with various forms of alcohol, and one of his results was that amyl alcohol in comparatively small doses rapidly produced peripheral neuritis. Dr. Kerr is the gentleman's name.

94. The practical significance of that observation would be, therefore, a *prima facie* case against beer producing peripheral neuritis?—Not necessarily, because ethylic alcohol he found did produce, only to a smaller degree, and in much slower time, similar results.

95. But beer does not contain any sensible quantity of amyl alcohol?—I was referring to ethylic alcohol.

96. I was asking with respect to amyl alcohol?—Beer in the ordinary way does not contain any perceptible quantity of amyl alcohol.

97. Ethylic alcohol would not be considered one of the higher alcohols?—No.

98. Therefore there is a *prima facie* case against beer producing peripheral neuritis?—No, because ethylic alcohol will also produce similar results, if continued for a much greater length of time.

99. You mean it requires much larger doses?—Yes, it requires much larger doses.

100. Whisky may, of course, contain sensible quantities of amyl alcohol?—It may.

101. And, therefore, there would be a *prima facie* case why whisky should give peripheral neuritis and beer not?—That is so.

102. But you do not find that is the case?—I should not like to say that whisky does not produce peripheral neuritis. I am inclined to think that whisky does produce peripheral neuritis.

103. But I rather gather that you told us that from your experience in Manchester you had not been able to connect peripheral neuritis with the habit of whisky

101. *H. Tattersall.* drinking?—I was trying to explain, and I may not have put it clearly. It is generally considered that spirit drinking is the cause of peripheral neuritis, but we found in Manchester that although whisky is a cause, beer is a commoner cause than has been generally supposed, even before this outbreak occurred.

104. I think the word you used was that it was the "predominant" cause?—I think that is our experience in Manchester, that it is the predominant cause, but it is not considered to be so elsewhere.

105. (*Sir William Church.*) Do you say it is the predominant cause of the disease you have had going on in Manchester?—Yes.

106. (*Chairman.*) Is there any difference between peripheral neuritis and what may be called alcoholic neuritis?—No.

107. (*Sir William Church.*) Peripheral neuritis may arise from many causes besides alcohol?—That is so.

108. Or mineral poisoning?—Yes.

109. For instance, to use a common illustration, it is an exceedingly common sequela to diphtheria and other diseases, and therefore I would like the Commission to understand that alcoholic neuritis and peripheral neuritis are not necessarily one and the same. They are both peripheral neuritis, but there may be peripheral neuritis, as we know, arising from other causes besides either alcohol or mineral poisoning?—Quite so.

110. (*Chairman.*) Peripheral neuritis produced by alcohol may be called alcoholic neuritis?—That is exactly what it is.

111. (*Professor Thorpe.*) I think it would be desirable that we should get clearly on the notes, if Dr. Tattersall could give us the information, precisely what he learned on the occasion of his interview with Messrs. Nicholson's, as distinct from what he gathered in the course of the evidence. How long was your interview with Messrs. Nicholson?—I should think about an hour.

112. Could you summarise exactly what you learnt?—That they had made no change in the source of their pyrites during the then current year, 1900, at any rate up to June. I only asked up to June—I asked from January to June—that so far as they could then remember—and they were not at their works, and the books were not available—they had always delivered to Bostock's ordinary B.O.V., brown oil of vitriol. Bostock's, they explained, were very small customers, and they had no personal knowledge of them in any way. They could not remember any change having taken place during that year that could possibly account for the alteration. They knew perfectly well that the common brown oil of vitriol contained arsenic.

113. Did they say that they knew that that which they sent to Bostock's contained arsenic?—No, they said that their common commercial brown oil of vitriol contained arsenic.

114. Did they lead you to infer that was what they sent to Bostock's?—They did.

115. (*Sir William Hart-Dyke.*) How many years had Bostock's been their customers?—I was told at Bostock's that they had been customers for 20 years.

116. (*Mr. Cosmo Bonsor.*) Had they changed the price?—The price, I think, had been changed at times during that period.

117. (*Sir William Hart-Dyke.*) And had they supplied precisely the same type of material, as far as their knowledge went, in 1900, as they had supplied 19 years previously?—With the negotiations subject to legal proceedings at the present time one naturally does not want to say anything very definite. But it struck me that the negotiations were rather loose. There was a want of clearness of understanding between the two firms.

118. (*Professor Thorpe.*) That is what you have learnt subsequently?—Yes.

119. You had not learnt that on the occasion of your interview?—No.

120. Did they state to you that they had no knowledge of the use to which the sulphuric acid was put by Bostock's?—They did.

121. Did they know, to your knowledge, that they were sugar refiners?—I could not say that. It is difficult for me now to say where what I told them ends and where what they told me begins.

4576.

122. But you would inform them, I presume, that samples of invert or glucose taken from Bostock's had been found to contain arsenic?—I did.

123. And that it was supposed to be derived from acid they had supplied them with?—I did.

124. Was it known to them for the first time that invert and glucose was made by Bostock's?—They did state that they did not know what Bostock's used the acid for. They had no idea what that acid was used for.

125. Did they have any idea either that they were in any way connected with brewing or brewers?—I do not think they had.

126. (*Chairman.*) Or with glucose?—The impression they gave me—I think I should put it as clearly as possible—the impression they gave me was that they knew very little about Bostock's; that Bostock's were small, regular customers, taking a small quantity regularly from a large works, and they never troubled about them one way or the other, and they did not give much thought to it.

127. (*Sir William Church.*) They were taking from 7 to 10 tons a week?—But I think Nicholson's produce about 500 tons a week of acid.

128. For manure making, do you mean?—For all sorts of chemical processes. They assured me, and this was a point I thought I ought to enquire into, that they did not send any acid to the maker of any food product of any kind other than Bostock's, and they did not know then it was used by Bostock's for that purpose. I thought it was important to ascertain that at once.

129. (*Chairman.*) Did Bostock's manufacture anything else than glucose, or were they manufacturers of glucose alone?—At the time of my visit they were doing nothing but making brewers' sugars.

130. (*Professor Thorpe.*) I suppose you wish the Commission to believe that it is your own opinion that this epidemic is clearly traceable to the use of arsenic in the particular manufactory of sugar, viz., Bostock's?—That is so.

131. That you think it is solely to be attributed to that circumstance?—I do.

132. And that to that extent it is an accidental occurrence?—Quite so.

133. (*Chairman.*) The statement at the top of page 26 regarding Bostock's is derived from the coroner's inquest, is it not?—Yes.

134. And marks where the change to Nicholson's took place in March?—Yes.

135. You had been told they did not know of any change between the beginning of 1900 and the beginning of June?—That is so. This was the first time I had it explained to me why the epidemic began in June, a matter which had puzzled me very much.

136. Clearly the information you got from them was defective, but you do not attribute blame to them, because they said they had not full information at the time that you called?—Although I came away from their works with no information of any value to me, they did not give me the impression that they were deliberately withholding information.

137. Had they had their attention called to it before?—They said they knew nothing about it until I saw them.

138. (*Professor Thorpe.*) Had they not yet learned of the matter from Bostock's?—No. They could not very well, because I was at Bostock's for the first time at five o'clock on the Friday afternoon in Liverpool, and I was at Nicholson's on Saturday at noon. Bostock's did not believe it was their sugars at that time which were poisoning people—they could not believe my statement. They said they had made their sugars in the same way for 20 years, and it could not possibly be their sugars. Therefore I do not think Nicholson's had heard anything from Bostock's.

139. At that time had the public been alarmed about the epidemic?—It was already in the public Press.

140. Was it in the Public Press at the time you called on Nicholson's?—It was in the Manchester evening paper on the Friday afternoon. How it got there I do not know—it was stated that I had gone to Liverpool to a brewers' sugar makers' works to enquire into the cause of the epidemic, but I do not know whether Nicholson's knew of that or not.

Mr. C. H. Tattersall.

22 Feb. 1901

Mr. C. H. Tattersall.

22 Feb. 1901.

Beer-drinking diminishing before cause of outbreak discovered.

Increase in Bostock's business after 1896.

Sicilian sulphur should be used in manufacture of acid used for food.

141. (Mr. Cosmo Bonsor.) Where is Nicholson's factory?—In Leeds.

142. What is the precise nature of the evidence you have as to the marked falling off in the consumption of beer—how did you learn that?—I learnt that from the brewers. One of the brewers told me that he had had a falling off in the consumption of his beer, and that he had enquired from other brewers if they had had a similar falling off, wondering whether something had gone wrong with his beer. He told me at that time that he had received information from other brewers that they had had the same experience.

143. Was that a brewer using Bostock sugar?—It was.

144. Were the other brewers to your knowledge using Bostock sugar?—Not all of them. That is the only source of my information.

145. That particular brewer?—Yes.

146. Did he say anything of the other brewers?—He told me in general terms that other brewers in the district had had a similar experience.

147. Did he mention their names to you?—He did not.

148. You had no knowledge then that they were using Bostock sugar?—A number of them were.

149. (Chairman.) When he told you of this falling off, had you let him know that there was this scare?—He knew then that there was something wrong with the beer, and that the beer was doing harm, because I had told him, but we did not know then that there was arsenic in the beer. It was before that was discovered.

150. (Professor Thorpe.) What is the basis for the statement that in 1896 Bostock's, who then became a limited company, pushed their business much more energetically in the districts of Salford than before?—I have ascertained that a brewery which since 1896 has used as much as 300 and 400 tons a year of Bostock sugar, prior to October, 1896, did not use any from Bostock's.

151. Have you had your attention as a medical man called to the possibility of this disease being attributable to something else than arsenic?—One had a good many possibilities to consider at first. I approached this thing purely from the public health standpoint; that is, a number of people were ill, and I enquired into all the circumstances, and I found one thing in common, viz., that they drank beer. Samples of that beer which they drank were found to contain arsenic—samples obtained in the ordinary course of trade from public houses from which a particular class got its beer was found to contain arsenic. Arsenic accounted for the symptoms, and I was satisfied without going any further. The arsenic was in sufficient quantity to account for the illness.

152. You specially indicate, as one method by which you think the recurrence of a calamity of this kind would be avoided, that all sulphuric acid which is used for the manufacture of food products, or all sulphuric acid which is in any way concerned in the preparation of food products, should be made from a single source, viz., native Sicilian sulphur. That is, I think, your recommendation?—That is so.

153. Are you aware, however, that it is not difficult to prepare perfectly pure sulphuric acid even from pyrites acid?—I am quite aware of that.

154. Would not the fact of limiting the production of sulphuric acid to what you call native Sicilian sulphur have the effect of very considerably enhancing the price of sulphuric acid so formed, without any very obvious advantage?—It seemed to me that, in the first instance, the preparation of sulphuric acid used for food purposes in comparison with the total amount of sulphuric acid used, is exceedingly small. It is only a small portion of the trade. I thought it was advisable to err on the side of safety. The fact that you can produce a perfectly pure sulphuric acid from pyrites I know quite well, and that such acid has been used in the preparation of this glucose and inverted sugar by some manufacturers without any injurious results I also know. But it seems to me that it ought to be impossible, as far as it can be made so, for a mistake to have any serious results. The sulphuric acid manufacturers, as a rule, do not make simply de-arseniated acid, but they make and sell for various trade purposes a much cruder acid, which is perfectly good for those purposes. It is certainly possible, to say the least, that a mistake might easily be made by a workman, because the carboys are packed and sent off by unskilled men, and there is nothing in the appearance of the acid that can make anyone certain it either does or does not contain arsenic.

It might be sent off and used by ignorant persons, to the serious detriment of the public health. I thought it was better to err on the side of safety, even if the price of acid for the particular purpose was somewhat increased. 22 Feb.

Mr. C. Tattersall.

155. Are you aware that there are other sources of supply of native sulphur than Sicily?—Yes, there are.

156. And it is also the case, is it not, that even native sulphur may from time to time contain small quantities of arsenic?—It does, I believe.

157. Therefore, if anybody were to solely rely on native sulphur as a criterion of purity of the acid, they might occasionally be mistaken?—They might get acid with some arsenic in it, but they could not get acid with much in it, not enough to do any harm.

158. Inasmuch as pure sulphuric acid can be made by proper treatment from pyrites, is not the real remedy not to prescribe that a certain form of sulphur should be used, but that a person using the acid shall be assured of its purity by analysis before he takes it into use?—That was presumed to be done in this case, and it shows you how easily that sort of guarantee breaks down. It is to guard against the breaking down of machinery of that kind that I suggest the other remedy. If a man has a works in which he uses nothing but native Sicilian sulphur for the production of acid, which is done, I believe, in some cases, it is an easy matter for the purchaser, if he so desires, to go to that works and see the sulphur on the premises being used in the production of the acid, and he cannot, no matter whether the acid be made strong or weak, whether it be made colourless or left coloured, get an amount of arsenic in that acid which is going to do much harm to his food stuffs.

159. Are you aware that other invert sugar makers or glucose makers use exclusively the oil of vitriol from pyrites or from native sulphur?—I know one firm of sugar makers who use entirely what is guaranteed to them as made from native sulphur. I know another firm who use the pyrites acid only, and other firms, I believe, sometimes use the one and sometimes the other, the main point being that it is guaranteed free from arsenic and that it is watched. It is that watching process that may break down, and that has broken down. The man who buys nothing but Sicilian acid, whether his watching process breaks down or not, is not going to damage the public.

160. Is there any evidence that those other makers of invert sugar or glucose have delivered their product contaminated with arsenic?—Not at all.

161. I think you said that you imagined this was a purely accidental circumstance in the case of Bostock's?—Yes.

162. How many invert sugar or glucose makers are there, to your knowledge?—I know of five.

163. Do you know of any instance in which they have delivered arsenicated products?—I do not. There are traces of arsenic in some of the sugars besides Bostock's, only they are traces that could not possibly account for any damage.

164. In your opinion, negligible traces?—Negligible traces.

165. Not more than would be contained in the malt?—Quite so.

166. Presumably in those cases the invert sugar or glucose makers have safeguarded themselves by analysis?—They presumably have.

167. (Sir William Church.) I think that you are a medical officer of health; you are not an analytical chemist by profession?—That is so.

168. Might I just ask you one other question? I suppose you have satisfied yourself that all the brewers who are on this list were supplied with Bostock's sugar?—I have. In two of the instances, the two where the largest number of cases are concerned, I found Bostock's sugar on their premises, and had it analysed. In other cases I have Bostock's assurance in each case that they had supplied those people. In two or three of them it has come from the brewers themselves in evidence at the various inquests that they did use Bostock's sugar, and one or two others I know personally from the brewers themselves in addition. So that I have two sources of knowledge with respect to every case.

169. (Mr. Cosmo Bonsor.) I suppose you have no sort of evidence as to how this sugar was used; whether it was used in the process of brewing or for priming?—It was used for both.

170. Have you the knowledge where it was used for priming rather than the ordinary process of brewing, that there were more fatal cases?—I have only one case where it was used for priming, and in that case they used it very largely in the other process as well, so that we got a double dose there.

171. The object of my question was rather to find out if you could tell the Commission whether the process of brewing with the sugar would not more or less destroy the arsenic that might happen to be in it?—It does, as I indicated. The process of brewing, I believe, does take out a certain proportion but it by no means takes it all out.

172. It would reduce it?—Yes.

173. And consequently it would reduce the risk if the sugar was all used in the brewing rather than used in the priming?—Yes, it would.

174. (Professor Thorpe.) Have you any idea how it would reduce that risk?—In the first place healthy non-arsenicated yeast takes up arsenic from arsenical wort, and that would take some out. Then again, some is deposited on the coppers and in the other processes, because the scrapings from the vessels have been found to contain traces of arsenic.

175. In the wort from which the arsenic has been abstracted by the yeast, would the wort have had the hops added to it?—Yes, it would.

176. Might not those hops have been sulphured hops?—They very often are.

177. Would not the fact of the sulphur in the hops tend to precipitate the arsenic as arsenic sulphide on the yeast?—It might, I cannot say.

178. Arsenic sulphide is a highly insoluble substance, is it not?—I believe it is.

179. (Chairman.) Would not arsenious B.O.V. be dangerous if used to prepare manure, for example, put on a turnip crop?—That is a thing I cannot say. The fact that vegetable crops do take up arsenic from the soil has been known for a great length of time. We have found a sample of barley with arsenic in it. That soil had been manured with manure that there is reason to believe contained arsenic. But I do not think any of these substances contain enough arsenic to do any-one any harm. That is simply an opinion.

180. (Dr. Whitelegge.) Can you say how many breweries there are in Salford?—Five.

181. Five altogether?—Yes.

182. How many of those do you regard as being supplied with Bostock's sugar?—Two.

183. The action that you told us of was taken mainly with regard to the breweries in Salford, was it?—Yes, mainly.

184. Did you communicate with the breweries outside Salford supplying Salford?—No, I communicated with their houses in Salford.

185. You told us of a large amount of beer being destroyed: is that beer from breweries or from public-houses, or from both?—That beer is from breweries only. There has been a large amount destroyed in public-houses, but I have no record as to the amount, and consequently I cannot include it. The amount there stated is a minimum, but there was more destroyed; although I do not know how much more.

186. Has any attempt been made to form an estimate of what I may call the beer drinking population?—There has not. It seemed to be impossible to get information of that character that was reliable.

187. Is it your general conclusion that the liability to arsenic poisoning of this kind has increased in proportion to the consumption?—I could scarcely say that. I think it increases more with the personal susceptibility of the individual.

188. That also; but from what you have read to us (Q. 8, p. 5) I drew the conclusion that although a large proportion of the cases were among small drinkers, yet presumably the small drinkers, although we have no exact figures, would be so much the larger population, that the case incidence would be relatively larger than in the other class?—Of course, the case incidence is presumably much heavier. In fact, I think from these figures the case incidence is heavier with the heavy drinkers, but the other factor is one that must not be lost sight of, the personal factor.

189. That you made very clear?—Yes.

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190. Have you thought of any other predisposing condition? You told us something about class; you do not think it was only the poorer class that was affected?—I do not.

191. Although your figures are more complete for that class?—They are.

192. As to sex, I understand from you the incidence is greater amongst women?—Yes.

193. Can you tell us with regard to the chart of deaths from peripheral neuritis (Appendix No. 1), what the sex distribution was in earlier years?—I cannot.

194. Could you find it out?—I could very easily ascertain.

195. Are there any industries carried on in Salford likely to cause arsenical poisoning in such a degree as to affect the result shown here?—Not to my knowledge.

196. Have you personally seen the cases?—I have seen a large number of them.

197. Could you tell us whether any of them were in a debilitated condition?—The cases that I saw when in bed were wasted and in a terribly weakened and debilitated condition.

198. From the disease?—From the disease.

199. But you had not any evidence pointing to debility as a predisposing cause of attack?—No. The history in many cases, especially in the males—has been to influenza the history of a healthy person suddenly becoming ill, and rapidly developing the various symptoms, which Dr. Reynolds describes better than I can do, of this particular poisoning.

200. The suggestion has been made that influenza as a debilitating condition might predispose. Have you any information on that?—I have no reason to think there has been any particular amount of influenza in Salford, any unusual amount, for some time.

201. When was the last epidemic in Salford?—We have had deaths referred to it for the last three or four years; but prior to that it was much heavier than it has been since.

202. You have had it in Salford each year?—Yes, each year.

203. In the early part of the year?—Yes.

204. Including 1900?—Yes.

205. By whom were the particulars of these cases obtained and analysed?—Some of the particulars were obtained by myself, and the rest were obtained by my chief inspector personally.

206. From the patient, or from the practitioner?—From the patient, from the patient's friends, and from the practitioner. Every means of information were used.

207. Had you a form which you used for the purpose?—I had.

208. Have you a copy with you?—I have not, but I will let you have one.

209. In applying to the practitioners for information, Extent and for what did you ask them—for the names or for the fatality of numbers concerned?—I asked for either, names where they did not object to my describing the cases, and numbers or letters where there was an objection.

210. Can you tell us how many practitioners there are, and how many gave you returns?—I cannot tell you exactly, because we have a large number of practitioners who do not live in Salford but practise largely in Salford.

211. But roughly?—I should think roughly we have about 100 practitioners, and about one-third of them gave me returns.

212. Did you obtain returns from all the public institutions?—I did.

213. On page 9, if I follow you rightly, you have included cirrhosis cases among those which may be properly referred to arsenic?—Yes.

214. And are those cases in which the cause of death is stated on the certificate as cirrhosis, without any mention of arsenic at all?—Yes. I had better explain exactly the way I have used these certificates. The diseases certified have been peripheral neuritis, alcoholism neuritis, multiple neuritis, or chronic alcoholism. There may have been such things as cardiac failure, or something of that kind following, Fatal cases of cirrhosis of liver, chronic alcoholism, and cardiac failure in relation to poisoning by arsenic in beer.

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but the certificates have obviously meant that and nothing else. In many of the cases of cirrhosis of the liver, peripheral neuritis has been mentioned as one cause of death, but it has been classed as cirrhosis of the liver in order that there should be no increasing of the deaths from peripheral neuritis unduly.

215. But still you think of the cirrhosis cases as properly belonging to the same group?—Some of them.

216. And caused in the same way?—Some of them. I think it is fair to look upon the exceptional increase in cirrhosis this year as being due to this cause.

217. As being due to the same cause that brought about the exceptional increase in peripheral neuritis?—Yes.

218. How long would it take for a case of cirrhosis, assuming it to be so caused, to prove fatal? You see what I am coming to. I am going to ask you how you associate the increased tendency to arsenical poisoning which is supposed to have arisen in the earlier part, or the middle part, of 1900, with cases of a long-continued disease like cirrhosis terminating fatally in the same year?—I associate it in this way. That one of the symptoms of many of these arsenical cases has been anasarca, and in many instances, certificates of death may be given without very careful investigation; that judging from the general symptoms, the fact that people were said to be drinkers, that anasarca was present, and that the liver was hypertrophied—I think I should refer here to the fact that post-mortem examinations have shown hypertrophied livers in these cases where there has been no amount of alcohol taken to account for that hypertrophy—taking those things into consideration, I take it that cases have been certified as due to cirrhosis of the liver when really they were due to arsenical poisoning. I think it is a mistake in the certificate.

219. Do you mean that there was no real cirrhosis, or that the liver was in an initial stage of cirrhosis only?—Dr. Dixon Mann found that in cases where the evidence showed that no large amount of alcohol had been taken, but that arsenic certainly had been taken, the liver was hypertrophied, and that that hypertrophy was due in his opinion to the arsenic. I think a practitioner in a case where he had a hypertrophied liver and anasarca, and was told that the patient was in the habit of taking drink, might very easily certify the death to be due to cirrhosis of the liver.

220. Do you regard that condition of enlarged liver as an early stage of cirrhosis?—That I cannot say.

221. Later on you mention that there were 107 fatal cases?—Yes.

222. That would correspond to a much larger total than 996?—That is so.

223. You have not seen your way to make any estimate of the total number of cases from the number of fatal cases?—I have not.

224. Can you tell us how many out of the 996 known cases proved fatal?—They include every one of the fatal cases, except the 22 due to cirrhosis of the liver, which have not been included in that 996.

225. On page 8 of your report you mention a certain number of slight cases; are those included in the 996? They are not.

226. Is the diagnosis of peripheral neuritis one that is readily made by an ordinary practitioner?—Certainly, in its more advanced stages.

227. And the diagnosis is improving, I suppose?—Yes.

Earlier cases
less severe.

228. Have you any explanation of the circumstances that the early cases were slight? You mentioned that as a fact I think?—I know it is a fact that the slight cases were common early on, but the explanation is not quite so easy. I am inclined to think that this epidemic shows what we did not think before, that arsenic is a cumulative poison to a much greater extent than we believed. I think that is one of the lessons of the epidemic.

229. And I suppose that possibly the beer earlier on contained less arsenic?—I do not think there is any particular reason to think that.

230. Did the analyst to whom you refer at page 28 receive any samples of beers brewed from Bostock's sugar?—No. We thought he might have done so, but he did not as a matter of fact.

231. Were the samples submitted to Professor Delapine taken formally or informally?—Informally.

232. Could you say that any sample that was tested was identical with one believed to have caused the mischief?—The samples which are marked on the Table A were obtained on the 16th of November from the shop from which a woman who had been ill, and who had been prosecuted for neglecting her children, and allowing one to die, obtained her beer. She had been found to be suffering from such mental disturbances that she could not be tried, and a subsequent investigation of her case showed it to be one of these arsenical poison cases. It was clearly one of the cases of illness that was then going about, and it was proved in evidence before the coroner's court at that time that she got her beer from this particular shop. I immediately went and obtained the sample A from that shop.

233. It might have been a later supply?—It might have been a later supply.

234. (Professor Thorpe.) But I suppose you had under observation a number of the employés in the brewery?—Yes, they certainly used that beer, but we do not know that they used it exactly at those dates.

235. (Dr. Whitelegge.) You mean this particular lot of beer in question?—Yes.

236. What are your statutory powers in relation to a matter of this kind?—They are limited to our powers under the Foods and Drugs Act.

237. And the Public Health Act?—I could scarcely say without reference.

238. Is it part of your official duty to take charge of the administration of the Sale of Foods and Drugs Act?—It is.

239. Under what instructions?—Under the instructions of the Town Council.

240. Are they formulated?—I could not say. I have never had any definite instructions other than those contained in the Local Government Board regulations; but there is a resolution on the minutes of the Health Committee directing me to conduct prosecutions under the Food and Drugs Act.

241. And to obtain samples?—I have a special inspector, who is appointed for that purpose, who does nothing else but take samples.

242. What number of samples roughly are taken in Salford in the course of a year?—On the average 750.

243. Do you instruct the inspector what samples to take?—I do.

244. Has he in former years taken samples of beer?—Up to 1897 he pretty regularly took beer. But in 1897 beer was stopped being taken, because it was found always to be right. The only impurity with which we had to deal was the question of adulteration with water, and it was scarcely worth while taking samples for that.

245. Were the samples of beer taken sent to the analyst simply for analysis, without instructions?—Yes.

246. And was the analyst's certificate to the effect that they were free from adulteration?—Yes.

247. You do not know, I suppose, what the analyst looked for?—No, I do not.

248. Do your instructions from the Local Government Board contain any reference to the administration of the Sale of Food and Drugs Acts?—Not that I remember.

249. Do you make any report?—Yes.

250. I mean any report specially on this, or is it part of your annual report?—It is part of my annual report.

251. I believe the Local Government Board, after the occurrence of this epidemic in Manchester, issued a circular, did they not?—Yes.

252. Have you had other memoranda or instructions dealing with the administration of the Sale of Food and Drugs Act from any Government authority?—Not to my recollection.

253. In the action that you took under the Sale of Food and Drugs Act in relation to these cases, did you go to the retailer for samples?—Yes.

254. What quantity was taken?—A quart was obtained in each case.

255. And that had to be divided into three?—Into three parts.

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256. Did you prosecute any of the retailers?—We commenced a prosecution, and it is still hanging over two retailers who sold beer that contained 1-200th grain of arsenic per gallon.

257. What would be your powers in relation to the brewer, and, let us say, a chemical manufacturer who supplied some of the material which passed through the brewery to the retailer?—As far as I have been able to gather, we have no powers to go past the retailer. We can punish the retailer, and the retailer can protect himself under a guarantee from the wholesale dealer, and then we can get at them; but apart from the question of a guarantee we cannot do it.

258. You cannot do it without a guarantee?—We cannot go past the retailer then.

259. (Professor Thorpe.) Have you no power by magistrate's order to go into a brewery and order something you know to be bad to be destroyed?—Yes, if we knew it to be bad. In that way it might be dealt with.

260. (Dr. Whitledge.) Under what statute?—On the question of the food being unfit for consumption—the Public Health Act, but as a matter of fact it was never necessary to exercise any powers. We simply requested, and all that we desired was carried out.

261. If there is no warranty, do you consider you have no means of approaching the wholesale dealer or the manufacturer?—I do not think I have.

262. Have you any experience of cases in which action has been taken on warranty?—I have not.

263. Would it be a convenience if the wholesale dealer or manufacturer could be associated in the case?—A very great convenience. It would save trying the case twice over for one thing.

264. And would it be an advantage that the person accused should have an opportunity of challenging and verifying the analysis of the original sample?—Yes.

265. There are other destinations of glucose, and I think you told us you have been looking into these in Salford?—Yes.

266. Has that been the practice in former years?—In what way?

267. The destinations of glucose other than beer—I mean the manufacture of some kinds of sweets?—We have taken samples of sweets prior to this outbreak.

268. Officially?—Yes, and at odd times we have taken samples of all kinds of substances.

269. You make certain suggestions at the end of your report as to provisions for the safety of the public. With regard to paragraph on page 38, what exactly did you think of as being the proper duties of the inspectors under the Central Government?—I take it that the works are practically under the supervision of the inspectors under the Alkali Acts. These inspectors visit these works, and it is a very easy matter when an inspector visits the works to see what is going out, and if it is not labelled as containing any poison, to take a sample and submit it to the Government analyst.

270. And would you extend that, not merely to any scheduled substances, but to all substances?—It is exceedingly difficult to define. Perhaps in the first instance it might be extended to scheduled substances. I do not see why a wholesale chemist should send out poison any more than a pharmaceutical chemist, unless it is labelled.

271. Then in paragraph 5, at the foot of page 38, you say "The Food and Drugs Act should also be amended so as to make the contamination of food stuffs with poisons in appreciable quantity, whether to a dangerous extent or not and whether to the knowledge of the seller or not, an offence within the meaning of the Act"?—I take it that an appreciable quantity would be what a chemist would consider a quantity that could be properly, and definitely recognised as a weighable quantity.

272. Do you mean a quantity that could be recognised by any test?—Not quite. I can conceive that tests might become so delicate that most minute quantities—what are often classed as traces—might be defined.

273. Are you prepared to suggest any limit from the medical point of view below which arsenic is immaterial?—In beer I do not think that any arsenic below 1-100th of a grain per gallon could do any harm.

274. Even in the extreme cases of which you gave us an example?—I do.

275. Where 1-50th of a grain produced symptoms?—Yes.

276. You would not think the habitual consumption for a long period of beer containing 1-100th of a grain per gallon would be harmful?—You see one-hundredth of a grain per gallon means one-eighth hundredth of that per pint.

277. I only want to get your opinion?—That is my opinion. I will put it perhaps rather in another way, that nothing more than 1-100th should by any possibility be allowed.

278. (Chairman.) Has there been prosecution of retail sellers for 1-200th per gallon?—There have been cases, but they have not been gone on with yet. We are awaiting the decision on the Manchester cases, and at present they are under adjournment. But it does seem advisable if the prosecution should take place on those lines for a legal definition to be obtained as to whether a person is legitimately allowed to sell beer containing 1-200th of a grain per gallon.

279. (Dr. Whitledge.) In your report you suggest an extension of the system of notification, do you not?—Yes.

279*. Will you tell us how you would think of applying it in a particular instance—what sort of schedule of notification you would use?—I feel confident that if this return from the Poor Law officials had been regularly sent to the medical officers of Manchester, Liverpool, and to myself, we should have noticed what one individual medical man may not have noticed, but which coming from several would have become more pronounced, a very distinct increase in the cases of peripheral neuritis, and that would in the natural course of events have caused us to enquire, and enquiry could not fail to have elicited the fact.

280. You are thinking rather of a complete return of all cases of pauper sickness?—Yes.

281. That comes later on in the suggestions, but I understood you to mean something rather different at this point?—The ideal condition to my mind is a universal notification of disease.

282. Of all diseases?—Yes, all diseases. But failing that I think it should be generally understood by the profession to a much greater extent than it really is, that there is machinery already provided for an enquiry into the causes of death, and that where sickness either unusual in character or unusual in amount occurs it should be reasonably expected that the practitioner should communicate with the authorities.

283. You mean an understanding rather than a statutory duty?—I cannot see how it could be made a statutory duty unless you were prepared to do the whole thing, and have what I believe is actually in existence in other countries—a universal notification of disease.

284. In this particular instance you would not have been able to formulate beforehand peripheral neuritis as a disease requiring to be notified, would you?—No.

285. Then, coming to your further point in the paragraph at the foot of page 39, Dr. Buchanan points out that that is hardly correct. Under the third article of the Order of the Local Government Board under which that duty arises, the words are, "Every medical officer appointed by the guardians after the 28th day of February, 1879, whether for a district or workhouse, shall immediately upon the occurrence of any case of contagious, infectious, or epidemic disease of a dangerous character amongst the pauper patients under his care, give notice thereof to the clerk of the sanitary authority of the urban or rural sanitary district as soon as may be, within which he acts as medical officer, or to the medical officer of health of such authority"?—If you read the order you will find further on that the clerk of the authority—

286. There is a further power, but it is optional with the Local Government Board, and they have not yet exercised that option?—That I did not know.

287. The suggestion is equally good either way?—Yes.

288. (Chairman.) Turning to the question of 1-200th grain per gallon, in certain cases in which prosecutions have been commenced, by whose test was the 1-200th grain in a gallon found?—The Reinsch test.

289. What quantity of the liquor was used?—A third of a quart. I cannot say of he used all that third, but that is the quantity he had supplied to him.

Mr. C. H. Tattersall.

21 Feb. 1901.

M.O.H and outbreaks of non-notifiable disease.

Tests for arsenic applied to Salford beers.

† Note.—An appeal on the cases in question was heard on May 13th, 1901, in the High Court, King's Bench Division (Goulder v. Rook; Bent v. Omerod; Lee v. Bent; Barlow v. Noblett).

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290. Is not that rather a small quantity to ascertain the facts when it is a question of a 1-200th of a grain in a gallon?—We found that when toxicological methods of enquiry are used, and proper care is taken—I have the exact quantities here—that from 50 cubic centimetres of beer you can ascertain 1-6th of a grain per gallon.

291. 50 cubic centimetres have sufficed to show the presence of 1-6th of a grain per gallon?—Yes.

292. Then surely a third of a quart would be a very small quantity of the liquor to show 1-200th of a grain per gallon?—1-200th is a very small quantity, of course. We have used in most of our analyses from 150 to 200 centimetres, and we have found no difficulty in demonstrating exactly 1-70th of a grain per gallon in that quantity.

293. Is it not the case that Professor Delépine has found considerably larger quantities than have been found in the same sample by public analysts?—That I cannot say. He found large quantities in the same samples that had been submitted to public analysts who did not find any, but for the simple reason that they never looked. They never attempted to find any.

294. Is Reinsch's test capable of giving quantitative results accurately?—I think so; that is the opinion we have come to.

295. Has Marsh's test been largely used?—We found very early that Marsh's test as used with beer is more difficult to work, and, in many ways, not very satisfactory, and we have confined ourselves to Reinsch's test.

Powers of
M.O.H. to
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296. (Sir William Hart-Dyke.) I am anxious that we should get it on our notes, and I would ask you to tell the Commission what you understand to be your statutory powers as a medical officer for the protection of the public health?—I can take samples—

297. Under what Act? There is the Public Health Act and the Food and Drugs Act?—They are the two Acts.

298. Are those the only two?—They are.

299. With regard to notification of disease, such powers as you exercise would be under the Public Health Act, I presume?—They would.

300. But under the Public Health Act have you any power whatever to go into a brewery and inspect the beer or test its quality, except when you have very strong evidence indeed that that beer being sold is very injurious to the public health from some cause or other?—No.

301. In that case, if you have strong evidence that poisonous substances are contained in it you have full power to examine and test the beer, but not otherwise?—Yes, but not otherwise.

302. With regard to the Food and Drugs Act, you have no power whatever for testing the quality of the beer, have you?—We can take samples of beer under the Food and Drugs Act, certainly.

303. How you like and when you like?—Yes, from the retailer.

304. But only from the retailer?—Yes.

305. And as regards the retailer, you have full powers to examine and test at all times?—We have.

306. And under all circumstances?—We have.

307. But not as regards the brewer?—No.

Powers of
M.O.H. to
enter
Brewery

308. (Professor Thorpe.) With respect to that, is it not the fact that supposing your public analyst had reported that a certain sample of beer purchased in the manner you have described under the Food and Drugs Act was found to be largely contaminated with arsenic, and you had the strongest possible evidence connecting that retail sample with the brewery, you could get powers to enter that brewery and order the destruction of that liquor?—I think under the Public Health Act I might. I have not tried to do so. The question has never been fought to my knowledge whether one could or could not, but I believe I have such powers.

309. (Dr. Whitelegge.) The powers in question would be powers of seizing in the same way that you seize food unfit for consumption?—Yes.

310. That is to say, you would seize it provisionally, and obtain an order from a magistrate?—That is so.

311. In what light do you regard the Sale of Food and Drugs Act, as a means of checking adulteration or

as a means of preventing damage to the public health? Mr. C. H. Tattersall.
—I have looked upon it entirely up to now as being a check upon adulteration.

312. Which I suppose would be largely harmless adulteration?—Yes, almost entirely harmless adulteration. I believe there have been some successful prosecutions in Liverpool under the earlier sections of the Act, but they have not been often used. I have never used them, and had no occasion to use them. When samples are taken under the Food and Drugs Act, and submitted to the public analyst, the public analyst examines the food submitted on the question of adulteration purely.

313. Has he no instructions to guide him in that matter?—No.

314. Has nobody attempted to formulate for the guidance of public analysts what the dangerous substances are that may be found in particular foods, or in what way he is to examine them?—Not to my knowledge.

315. (Chairman.) Do you think more safety could be had for the public by giving instructions to public analysts to find more than merely adulteration; that he should be expected to find for himself anything deleterious?—At present the public analyst is an outside servant of the corporation—he is not entirely employed by it, and usually he is paid either a retaining fee and so much a sample, or a fee per sample, and for him to be expected to do work which must be more or less of an investigating character would be unreasonable. It would be unreasonable to ask him on the ordinary scales of remuneration to examine, say, a sample of beer for all known poisons. It would take him a long time, and necessitate a great amount of labour, and to pay him the 2s. 6d. fee for an examination of that sample would be ridiculous.

316. (Dr. Whitelegge.) Would you expect a public analyst, without any further instructions, to examine for arsenic any sample of beer that came to him officially?—No, I should not.

317. Even in the face of the recent epidemic?—He probably would.

318. But you think it would not be a reasonable requirement in general?—I think he would be much to blame if he did not under the present conditions.

319. (Chairman.) Do you not think an amendment of the law or regulations respecting public analysis might be desirable, that there should be grades of investigation, an ordinary investigation, under a 2s. 6d. fee, or a more thorough analysis and a corresponding payment?—Yes, I think, as I say here, that the earlier sections of the Food and Drugs Act should be amended to make it more possible to get at the offenders in cases where deleterious substances have found their way into articles of food, and that analyses taken under those sections should be paid for under a different scale, and in a different manner from ordinary analyses for adulteration.

320. (Dr. Whitelegge.) Who do you suggest should decide between the one kind of analysis and the other?—I think it would be a proper thing for me to take samples for any specific purpose, and samples could be submitted to the borough analyst for one purpose or the other, or possibly for both.

321. The decision should rest with the medical officer of health?—Yes.

322. (Professor Thorpe.) But your local powers are quite sufficient to enable you to do that now?—Quite so.

323. You do not want fresh legislation to enable you to do that?—No. Only when the analyst has made his examination, and found the deleterious substances, I shall be able to get at the person who sold the article.

324. Do you mean the wholesale seller?—Either wholesale or retail. The retailer, if he has not protected himself. A retailer under the Food and Drugs Act can always protect himself by a warranty.

325. Are you not aware that in the Act of 1899 there is machinery to connect the wholesale man with the retailer, if the prosecutor chooses to set it in motion? I do not recollect those provisions of that Act.

326. Under the amended Food and Drugs Act 1899 the Court can order the wholesale man or anybody who has been connected with the distribution of the food in England, to be associated with the party who

Effect of
Warrant
obtained
dealer.

C. H. is charged in the indictment?—That is a power of the Court, not of the prosecutor.

1901. 327. The prosecutor can do it—the town clerk can do it?—I do not remember that.

328. (Chairman.) I suppose he acts on behalf of the Committee, and merely does it on the part of the Committee?—Quite so.

329. I think you told us additional legislation would be needed to allow those responsible for the public health to put more work on the public analyst than is at present put upon him?—I think under the earlier sections of the Food and Drugs Act, which deal with deleterious substances which may get into food, there is no offence unless you can prove that the person implicated had actual knowledge that it was there, and it is almost an impossibility to prove that. My contention is that that question of knowledge should be done away with, and that if deleterious substances are found, the person who sells the article, or the wholesale dealer, if he can be either associated with him or made responsible by warranty, should be prosecuted, whether he knows, or whether he does not know. If he

does not know he must take proper precautions in the course of his business to get to know.

330. And for that purpose would an amendment of the law be required?—It would.

331. In respect of a public analyst, I understand now that no additional legislation is required in order that you may give more work to him, and pay him accordingly. You can give him more work and pay him under the present Act?—The way in which the analyst does his duty is simply an arrangement between the analyst himself and the corporation that employs him, and that could be arranged. There would be no difficulty with regard to that, so far as I know.

332. So that what you want in the way of legislation is something to the effect of fixing the responsibility?—That is so.

333. (Chairman.) The Commission is very much indebted to you for the evidence, the valuable information, and the expressions of opinion which you have given, and I desire to thank you in the name of the Commission.

Dr. ERNEST REYNOLDS, called; and Examined.

E. S. 334. (Chairman.) You are, I believe, Assistant Physician to the Manchester Royal Infirmary and Visiting Medical Officer to the Manchester Workhouse Infirmary?—Yes.

335. Can you give the Commission information as to the symptoms found in the condition commonly called alcoholic paralysis?—In this condition, which has been called for many years alcoholic paralysis, there are certain sensory disturbances, quickly followed by certain motor disturbances, certain heart symptoms not infrequently, and also not infrequently certain quite peculiar mental symptoms. The sensory symptoms consist principally of prickings and burnings in the hands and feet, and cramp in the calves, and they are associated with a very exquisite tenderness, which is found on pressing or squeezing the muscular mass between the fingers. That peculiar tenderness is found in very few other conditions; as far as I know, it is only found in the so-called alcoholic paralysis, in arsenical paralysis, and I believe, although I have not seen cases, it is found in beri-beri, a tropical disease. I am also informed, although I have not seen cases, that occasionally it is seen in the paralysis following diphtheria. As regards the motor symptoms, these consist of gradual loss of power in the feet and hands, the loss of power being due largely to an inflammation of the nerve trunks in the limbs, or, in technical language, peripheral neuritis. This loss of power is so peculiar, that a peculiar form of gait is produced; the person always walking, or nearly always walking in a way which is more or less typical of the affection. At the same time the hands become paralysed and drooping, and in many cases in the advanced stage the diaphragm becomes paralysed, so that there is very great difficulty in breathing. At the same time, in many cases you have a dilatation apparently, or at any rate, a failure of the muscle of the heart, so that you get breathlessness and dropsy of the feet. In some cases you get the peculiar mental symptoms which I have just mentioned, these mental symptoms consisting of a very characteristic loss of memory of time and of place, so that a patient does not know at all how long he has been in the wards. If patients have been lying paralysed, say, for three or four months, and you ask them where they were yesterday, they will probably tell you they have been out for a walk. Many of them are quite incapable of saying where they are. They think they are somewhere else, and they will tell you that that morning they have been for a walk somewhere or other. Those are the symptoms we have known now for many years, and such cases, as far as I can tell, are very common in Manchester; very common in the years 1887 to the end of 1899 at the Manchester Royal Infirmary. I take these figures, because they are more available than the figures at Crumwell, which is a larger place, where we have not proper help to get out such figures. But at the Manchester Royal Infirmary, where they have 1,500 medical cases admitted every year, the average number of alcoholic paralysis cases from 1887 to the end of 1899 was 20.

336. Twenty annually?—Yes. So that the cases are really quite common in Manchester.

337. Are these cases more common in Manchester than elsewhere, so far as comparison can be made?—As far as

I can hear, I think they are more common in Manchester than they are in many other parts at any rate. They are more common in Manchester, I think, than they are in Scotland, and I am inclined to think that they are more common proportionally in Manchester than they are in London, but I cannot speak positively of that.

338. (Professor Thorpe.) How do they compare with Liverpool?—I think they are about the same.

339. (Chairman.) Do you attribute that to a greater consumption of alcohol in Manchester than in London or Scotland?—No, certainly not than in Scotland.

340. Still, you would call it properly alcoholic paralysis?—That is what it has always been called. I wish to say more about that in a moment or two.

341. Can you say anything about the symptoms generally found in chronic arsenical poisoning as known previous to the present epidemic?—In chronic arsenical poisoning you get, as a rule, first of all, digestive disturbances, vomiting and diarrhoea. You next get symptoms of a cold in the head, running of the eyes and the nose, and frontal headache. About this time you get in not a few cases peculiar acute rashes on the body; rashes like measles, sometimes like scarlet fever, and rarely, but well described, herpes or shingles. You then get marked sensory disturbances exactly resembling the sensory disturbances I have just described as occurring in alcoholic paralysis. Then you get motor disturbances almost exactly the same as I have already described in alcoholic paralysis. I have now seen a considerable number of arsenical cases, and I have seen a large number of alcoholic cases before this outbreak, and I cannot differentiate between the sensory and motor symptoms of those occurring during the present epidemic and those which I have seen previously, taking the cases altogether. You also get in chronic arsenical poisoning, later on, certain chronic skin affections marked by a peculiar pigmentation of the skin, and by a peculiar thickening of the palms of the hands and the soles of the feet. I ought to have said in acute skin affections you also get, with the burning, a very marked redness of the palms of the hands and the soles of the feet, the hands and feet looking as if they had been stained with red ink. At the same time the hands and feet sweat very profusely. I may mention that exactly the same signs have already been described as belonging to alcoholic paralysis, that is to say, the redness of the hands and feet, and in some cases the thickening of the soles of the feet has been described as occurring in the so-called alcoholic paralysis. But pigmentation of the skin has never been described, as far as I can find, in connection with alcoholic paralysis so-called, nor have there been any of the other acute eruptions.

342. Is the pigmentation a sure sign of arsenic?—No, the pigmentation is a sign that occurs in many conditions. It occurs, for instance, in tramps who have been very much troubled with body vermin, lice on the body. It occurs also in a disease known as Addison's disease, which is very similar to, but not quite the same as, arsenical poisoning, because in Addison's disease you get also pigmentation inside the mouth, which as far as I have seen does not occur in arsenical poisoning. Therefore the pigmentation does

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Chronic arsenical poisoning clinical characters, paralysis, affections of the skin, pigmentation.

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Alcoholic
neuritis in its
relations to
arsenic.

not tell one very much; it only helps. Comparing the symptoms of so-called alcoholic paralysis with those of chronic arsenical poisoning, one would say that the sensory and motor symptoms are practically the same, but the skin symptoms are only found in the arsenical cases, and not in the so-called alcoholic paralysis cases. To show that this is so, I may say that this epidemic in Manchester had been going on for four months, and many physicians there, gentlemen who were thoroughly well acquainted with the appearances of alcoholic paralysis, who had been observing these cases for all that time, had no suspicion of the sensory and motor symptoms that they were anything but alcoholic paralysis. That shows how close the resemblance was. It was not a question of merely one observer, but of many observers who were well acquainted with alcoholic paralysis.

343. There are other forms of neuritis, lead, diphtheria, and so on; what have you to say about them?—In the other forms of neuritis you always get something which is quite characteristic. Between the alcoholic and the arsenical neuritis, putting aside the skin symptoms, the appearances are practically the same, although they are two such very different poisons. In lead you get quite other forms, the muscles picked out are quite different. There are no sensory phenomena. In diphtheria, again, the muscles picked out in neuritis are quite different from the others. But in arsenic or alcohol the symptoms are practically the same, and this is a curious point.

344. Have you any reasons for doubting whether ordinary alcohol is, or is not the cause of the so-called alcoholic paralysis?—That is a very difficult question, and I only wish to put my views forward with great diffidence, but there are several points that make me think that alcohol *per se*, ethylic alcohol, perhaps I should say, is not the cause of neuritis. The reasons are as follows:—It was stated for many years—and it is quite an old affection which has been described many years ago—that alcoholic neuritis only occurred in spirit drinkers. The first case of alcoholic neuritis I ever saw was in 1836, sixteen years ago, and that occurred in a gentleman who drank absolutely nothing but beer. He was in an institution where I was medical officer at the time, and we knew exactly what he took. He took nothing but beer, and he developed very marked alcoholic neuritis. This case was reported by Dr. Dreschfeld some years ago, and at that time Dr. Dreschfeld said he was perfectly certain the patient also took spirits, because otherwise he would not have had neuritis. I am only telling you this to point out how certain people felt that it was caused by spirit drinking. This first case was a pure beer drinker. Since then I have seen many hundreds of alcoholic neuritis cases in hospital work, and they have invariably taken beer either alone or with spirits. I have seen many cases in private and in hospital work where people have taken nothing but spirits, and personally I have never seen a pure spirit drinker with alcoholic neuritis. I have been called in to see ladies and gentlemen who have taken, say a bottle of whisky a day, but they never had neuritis. Only within the last two or three months I have seen two such cases in consultation. One was a lady who took a bottle and a half of whisky a day, and another a bottle a day, and neither had the slightest trace of neuritis. Therefore, it seemed curious, if it were alcohol, that no trace of neuritis should be found. At various times I made enquiries from Scotch physicians, and I have been astonished to find there was so little neuritis in Edinburgh, or Glasgow. Some weeks ago now I sent to Aberdeen, Glasgow, Edinburgh, Dundee and Belfast, to ask if it were a common affection, and from the answers I received I found that my opinion that it was not alcoholic *per se* was corroborated. Last week I received an unsolicited letter. I had not written to Sir William Gairdner, but I received from him a letter on this subject, which I have his permission to use. It is published now so that if I may be allowed I should like to put that letter in. It is as follows:—"Edinburgh, February 7th, 1901. Dear sir,—I have had no desire to join in the confusion which Mr. Malcolm Morris remarks upon in the 'Practitioner' as the 'Beer scare,' but it may possibly be interesting to you to know the following, which I communicated to Sir Lauder Brunton some time ago, and at a later date to Lord Kelvin. At a date which could be approximately fixed from the fact of my being engaged at the time as an examiner for Victoria University, I had read the late Dr. Ross's account of

alcoholic paralysis; but had (or supposed I had) almost no personal experience of the disease. Meeting Dr. Ross accidentally when in the midst of the clinical examinations at the Royal Infirmary, I asked him to show me some cases and, to my great surprise, he took me at once to (I think) half a dozen or more, which he at that very time had in his wards. His demonstration of the disease was most convincing; but after fully acknowledging this I said to him, 'But if this is alcoholic paralysis, how does it come about that I did not know it well before, and seem scarcely to have seen it in Glasgow, where they drink so much whisky?' This thought remained with me and kept me on the watch—as a teacher of medicine—and the few cases I afterwards saw, either in hospital or in private practice, only convinced me the more of the rare and exceptional character of the disease in Scotland, and that alcohol (though certainly associated with the disease) was not the leading factor in the etiology. I give you every credit for the remarkably interesting investigation by which you reached the truth; but no such investigation was possible for me, as the cases were so few and far between. Such as they were, however, they were always so typical that I had no difficulty about the diagnosis, and was thus the more convinced that I could not have overlooked the type, had it occurred to me in any considerable number of cases, prior to my encountering Dr. Ross, for whom, then and afterwards, I always entertained a most sincere respect, and have accordingly read, I think, everything that he wrote upon the subject.—Yours most truly, W. T. Gairdner." That letter from Sir William Gairdner showed me that I have not been mistaken in doubting whether alcohol *per se* would cause peripheral neuritis. What it is that is associated with the alcohol I cannot say. But I should like here to point out that there cannot in my mind be any doubt that neuritis has been caused by spirit drinking *per se*. For this reason: the accounts given in 1789, for instance, that given by Dr. Lettsom in 1789, are perfectly clear. The account he gave there of symptoms occurring in women drinking brandy is a perfectly typical account of what we called alcoholic neuritis. Then again, Sir Samuel Wilks, about 1830, described perfectly typical cases of alcoholic neuritis occurring in spirit drinkers. So that, although I have said that I have not seen it in a pure spirit drinker, yet I cannot doubt that it has occurred in spirit drinkers; but certainly in the Manchester districts it is infinitely more common in beer drinkers or in people who have their drinks mixed, spirits and beer. From Sir William Gairdner's letter it would seem that it is certainly not common amongst pure whisky drinkers.

345. (Chairman.) Have you found it in the case of beer drinkers in excess?—Previously to this epidemic only in beer drinkers in excess.

345.* Was there any suspicion of any mineral poison being connected with the illness until the present epidemic?—Until the present epidemic one did not certainly connect it with any mineral poison, but about June last year I saw in the same week several cases of the redness of the hands and feet, which I have described, known as erythro-melalgia, the older term being acrodynia—simply a painful extremity. Those cases were always supposed not to be very common, but in one week in the out-patient department I saw several cases.

346. (Sir William Hart-Dyke.) About what date was that?—July, 1900. I think it was the first week in July, because I gave a clinical lecture on the cases I had seen. When I returned from my holidays, about the beginning of September, in going round the wards at Crumpsall, where there are about 800 beds with medical cases in them I noticed a considerable number of cases of alcoholic paralysis. The residents had also remarked it, and we then found in one pair of wards, containing 62 beds, 25 cases of this paralysis. They began to increase in the most alarming way. I ought to say that we also noticed both in the infirmary and at the workhouse during these two or three months a considerable number of patients with most peculiar eruptions, some looked like measles and some like scarlet fever. We also noticed a considerable increase in the number of cases of shingles.

347. (Sir William Church.) This would be in May, June and July, you are speaking of?—Yes; then on the 15th November, in chatting with one of the assistants at Crumpsall, over the various skin rashes we had seen in those cases, Dr. Simons, the resident there, mentioned to me that I had forgotten to mention herpes; and then it suddenly flashed across my mind, "Why, there must be arsenic in the beer the people are drink-

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ing." We had already shown pretty clearly that all the patients who were suffering were beer drinkers. This seemed very unreasonable, but my reason for suggesting it was that if it were any known drug in the beer, then it was probably arsenic, because of all known drugs arsenic is the only drug which causes shingles. It then, of course, became a simple matter. I obtained some of the beer on the 17th November, and on the 18th November I tested it by Reinsch's method and got a considerable ring of crystals of arsenious oxide in my reduction tube. On the 19th November I communicated this to Dr. Dixon Mann, who was far more skilled in this work than I was, and on the 20th he obtained from a separate sample of beer—I believe it came from the same brewery—crystals of arsenious oxide.

343. (Chairman.) That was the first knowledge of the present epidemic?—Yes.

349. Had you heard that beer drinkers had become alarmed by feeling themselves ill a month or two months before that time?—I only heard that afterwards.

350. Did the symptoms in the present epidemic agree with the symptoms you have been already describing, or were some new class developed?—They agreed exactly with the symptoms I have been describing as occurring in arsenical cases. They also agreed absolutely with the epidemic which was called acrodynia, which occurred in Paris in 1823, and described by Genest in the "Archives G n rale de M decine" for 1823 and 1829. The same epidemic is also described in a thesis by Rochette, published in 1871, in which the whole of the symptoms are very carefully given. In the 1823 epidemic nobody imagined that it was arsenical.

351. In the earlier case was it imagined to be arsenical?—No, nobody imagined it was arsenical. Nobody ever knew what that epidemic was. It was very extensive, but nobody imagined what it was until another epidemic occurred in Hy res in 1889. That was undoubtedly arsenical, and was due to arsenic having been put into wine instead of plaster. Plaster, I believe, gypsum, is put into wine for some purpose or another, and instead of the gypsum arsenic had been put in, and that caused an epidemic in Hy res, with about 400 cases.

352. Were there any deaths?—I do not know how many deaths there were.

353. Did this last a considerable time?—Yes, for some time.

354. Was it early discovered to be due to something in the wine?—Yes; in that case the pigmentation gave the key to the difficulty in the Hy res epidemic.

355. And this was just one lot of wine?—Yes.

356. Was it called acrodynia?—Not in the Hy res epidemic. The other epidemic in 1823 was simply described as acrodynia. A commission was appointed, and I have read its report, but it came to the conclusion that it did not know what it was.

357. In the light of subsequent knowledge, does there seem any probability that arsenic may have been the cause?—The symptoms are so well described in that epidemic that I felt I must have copied from the Report in my paper which I wrote on this epidemic a short time ago. The two papers are most ludicrously similar. Expressions are used in the same way, and I had not seen the paper on the previous epidemic before I had written my own. The descriptions tally exactly.

358. There was a second case in France, I believe?—Yes, another at Havre. That is a very interesting case, because there it was homicidal. There were 15 people affected, and three died. It was investigated by Brouardel in 1889, and is reported in the *Annales de Hygi ne* for 1889.

359. It was homicide by poison?—Yes, by arsenic.

360. Was it known to be arsenic?—Yes. Brouardel found that out, and it was clearly shown to be arsenical poison. In those cases again, the symptoms were exactly similar to the symptoms in the present epidemic.

361. That makes it probable that the case in Paris in 1823 may have been arsenic?—I do not think there can be the slightest doubt about it.

362. Looking back on it now, is there any suggestion as to how it could have been arsenic?—I think it was probably accidental.

363. I think you have described the chronological order of the symptoms?—The chronological order can be put very shortly in the present epidemic. The digestive symptoms have started first. In many cases we

found these digestive symptoms, and I should say that perhaps 50 per cent. of the cases had either vomiting or diarrhoea while they have been drinking this particular beer. Sometimes the symptoms have been those of cold in the head, and the irritation of the larynx, and the less irritation of the bronchii, giving rise to laryngitis, and to bronchitis. About this time the acute skin lesions have appeared, the acute rashes. Within a few days, sometimes almost at the same time, we have had the sensory disturbances, burning of the hands and feet; and then in about three or four more days the patients have complained of the loss of power, especially in the feet, and partly in the hands. About 75 per cent. of the cases have complained of some loss of power, and in some cases the loss of power was so great that they could not move at all. They were lying perfectly helpless, paralysed, in bed. About this time, or after, one noticed the darkening of the skin, and later on the thickening of the soles of the feet and the palms of the hand.

364. What would be the earliest time in 1900 when the severe symptoms you have just described were observed?—The cases of erythro-melalgia, or painful hands and feet, which I first saw were at the end of June.

365. And did they develop with full severity such as you have described?—They developed pretty quickly.

366. Were they in full severity in June?—Yes, but they were only cases showing the redness of the hands and feet. They were early symptoms undoubtedly, and many of them got worse afterwards.

367. In July or August?—In August I was away for my holidays, but when I came back in September, I found this great increase in the numbers of so-called alcoholic paralysis at the workhouse.

368. So that in September the epidemic seems to have been fully developed?—Yes; but our maximum of cases occurred in November. This table illustrates the point.

ESTIMATE of Cases suffering from marked Alcoholic or Arsenical Symptoms admitted to Manchester Workhouse Infirmary in 1900.

	Males.	Females.	Total.
January - - - -	4	6	10
February - - - -	5	2	7
March - - - -	3	4	7
April - - - -	7	3	10
May - - - -	16	3	19
June - - - -	21	11	32
July - - - -	25	7	32
August - - - -	15	11	26
September - - - -	32	18	50
October - - - -	40	39	79
November - - - -	55	53	108
December - - - -	40	24	64
	263	181	444

369. Have you any remarks to make with respect to classification of cases?—This has been a little difficult, and it is largely due to the peculiar idiosyncrasy which people seem to have as regards arsenic. For instance, in some cases the wife has been so bad that she has died, and there has been a coroner's inquest, and the husband, who said he took quite as much beer of the same kind, or perhaps more, than his wife, was hardly suffering at all. Those occurred in one or two instances.

370. Then there were coroner's inquests before the epidemic became generally known?—No; I mean coroner's inquests since. I am only giving that as an instance, to show how some people were affected, and others not affected at all. Therefore, it is a little difficult to classify the cases; but one might classify them somewhat in this way: One group presented practically all the symptoms, another group only presented symptoms of heart or liver affection; that is to say, they were breathless, and had swollen feet, and perhaps a very few sensory disturbances. Other cases, again, had principally sensory disturbances, and nothing much else, and other cases had sensory and motor disturbances. It was these latter cases, the sensory and motor cases, presenting practically no other symptoms, which looked exactly like the old cases of alcoholic paralysis; but even in these cases a careful examination of the soles of the feet not infrequently revealed scales, so that it seems to me very probable that many of the cases which we have been calling alcoholic-paralysis for some years now, if we

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Symptoms of the epidemic cases.

Statistics of cases in Crumpsall Infirmary.

Individual susceptibility to arsenic.

Different types of disease met with during the epidemic.

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Cumulative
effect of
arsenic.

Individual
susceptibility
to arsenic.

Affinity of
arsenic to
certain
tissues.

Cardiac
failure.

had only known of the small symptoms to look for—the scales on the soles of the feet, the slight duskeness of the skin, and so on—we should have not only looked for them, but found them and called it by something else. We simply did not know of their probability. Since then we have always looked for them, and in most of the cases we have found them. In this classification I should just like to throw out another suggestion, which is merely a suggestion. It seems to me possible that quite small quantities of arsenic—not the comparatively large quantities which have been present in this epidemic, but quite small quantities—taken for considerable periods, may, by accumulating in the system, as this epidemic has shown they will accumulate, set up paralysis without any of the other symptoms. We know that lead in quite minute doses, taken for long periods, will gradually set up a neuritis, and the resemblance of the alcoholic neuritis and arsenical neuritis is so extraordinarily great that it seems to me quite possible very large numbers of these cases for some years have really been due to quite minute traces of arsenic in alcoholic liquors. That, of course, is merely a suggestion, which I cannot prove in any way.

371. How small do you think these very minute traces may be?—I should not like to attempt to give any size of dose, considering how peculiarly susceptible some people are to arsenic. For instance, in some cases 1-25th of a grain taken three times a day for two or three days will cause symptoms of arsenical poisoning, acute symptoms. The 1-25th of a grain of arsenious acid taken three times a day for a few days has been known to cause fairly acute symptoms of arsenical poisoning.

372. Amounting to about $\frac{1}{2}$ of a grain a day?—Yes, but that is only in a person very susceptible to it.

373. That would be taken in three days; but suppose the same quantity was taken in a large quantity of liquor, would not the greater part of it pass through without producing any disturbances at all?—It has been always supposed that it would, and it has been supposed that arsenic was very quickly eliminated by the urine; but this epidemic in reality has only revived what was known before, in France, at any rate, that arsenic is stored up in very large quantities in the body. It is stored up in the skin, in the hair, in the nails, and in the bones. Therefore, instead of its being rapidly eliminated, as many books have stated, it is nothing of the kind—it is stored up in the body, and seems to be selected in a peculiar way by certain organs of the body.

374. Taken in a solution, such as Fowler's solution for instance, will the tissues take the arsenic out and send the liquid away?—Yes, there is no doubt about that at all.

375. We do not know, except from this epidemic, the results of small quantities of arsenic in alcoholic drinks. Are we to suppose that the arsenic in the beer was dissolved?—That I cannot speak about, not being a chemist, but I should imagine it was dissolved in the beer. You see it would have to pass from the stomach through the liver before it could get to the kidneys, and it is in the liver apparently where it gets first seized upon.

376. And in the body it may be taken out from solution?—Apparently a considerable amount of it may be taken out of solution. At any rate, it does certainly get stored up, because even in this epidemic it has been found in the scales of the skin. The scales that have come off the hands and feet have been examined. I suppose you will get the evidence from others. I have not examined them, but arsenic has been found in these scales, and it has also been found in the hair and in the clippings from the nails of these patients.

377. In considerable quantities?—In weighable quantities.

378. And in post mortem examinations has there been much found in the tissues?—There is nothing very much in the appearance at the post mortem which would show there has been arsenic unless the tissues are examined carefully. The liver has been enlarged and fatty and in a state of chronic inflammation in some cases. In other cases the heart has been fatty and very dilated. In fact, most of the patients have died from heart failure just as they did in the Havre epidemic. The three cases there died from heart failure. But beyond that there has not been very much change that you could lay hold of; certainly in the naked eye appearance you could not have possibly said it was arsenical poisoning

You could only tell it by chemical analysis of the tissues.

379. Could you tell us the number of cases personally dealt with at the Crumpsall Workhouse and at the Manchester Royal Infirmary?—The number of cases I have seen since the beginning of 1900 in the Crumpsall Workhouse at Manchester has been: Males, 263; females, 171; or a total of 434. At the Manchester Royal Infirmary in the out-patient department in November and December—I have not counted them since—there were: males, 110; females, 60; total, 170. Since then I have seen at the infirmary a considerable number of others. I expect I have seen about 650 cases personally.

380. What were the number of fatal cases?—15; 12 women and three men.

381. So that the fatal cases were more numerous amongst the women than the men?—Yes. And that brings us back to another point. Severe symptoms were much worse in women, and I think for this reason in the early part of the epidemic not only myself but others thought that the disease was more common in women. Possibly it might be if you take the percentage of those who drink beer amongst women and amongst men. That, of course, is a very difficult thing to get out. But of the actual number of cases coming to a hospital it has been more common in men. Again, there is another little fallacy here. Some of the women, especially after it was known what these symptoms were due to, became very shy, and unless they were suffering very severely would not come to the hospital, because they knew that these symptoms meant that they had been drinking beer. After it was known what the symptoms were due to they stopped coming to a large extent unless they were really very bad; but the severity of the symptoms were much worse in women, and the deaths, as I have said, were six times as common as in men.

382. Which were six times as common?—The deaths. Women were about six times as common in women as in men, severely taking the percentages. Exactly the same thing was noticed in alcoholic neuritis years ago, that it was much more common, or the symptoms were much more marked in women than in men.

383. (Dr. Whitelegge.) Do you mean that the cases were more numerous or more severe in women?—They were said to be more numerous, and I think they were.

384. And were they also more severe?—Certainly. We got more actual paralysis and helplessness in the women than in the men.

385. (Chairman.) Do you attribute that to the women having drunk more than the men or being more susceptible?—To being more susceptible. As regards the women, I am quite sure, from a very searching examination of some of these people—and I have examined some hundreds of them—some of them had not taken more than what they called three half-pints a day; that is to say, a pint and a half of beer per day. Many of the women did not take more than a pint and a half of beer a day.

386. That would not be at all more than would be good for their health if the beer had been pure?—I think not.

387. Is Crumpsall Hospital a workhouse infirmary?—Yes.

388. Did the patients get beer in the workhouse?—No, the patients did not get any beer in the workhouse.

389. Does the workhouse hospital take patients other than from the workhouse?—Yes, from the whole of the township of Manchester, which is the central part of Manchester.

390. Why it is called the workhouse infirmary?—Because it is under the Poor Law.

391. I misunderstood you; I thought it was the hospital of the workhouse?—It is the workhouse infirmary. There is a workhouse close by.

392. But it is not confined to patients from the workhouse?—No, it is open to any poor people.

393. Have you any further information or opinions to give regarding previous epidemics of arsenical poisoning?—Only those I have already mentioned.

394. Have you any further information you would wish to give us?—I do not think so.

395. (Sir William Church.) You say rightly enough that the profession has been long acquainted with what was called alcoholic paralysis, but could you tell me how long it had been made use of in Manchester by the

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statistic

F. S. Registrar of Deaths?—I should say since about 1885. I fix that date for the reason that at that time I was at Cheshire Asylum as a resident medical officer.

1891. 396. It certainly would not be before that, because it was not in the nomenclature of diseases till then?—Very possibly. I did not know that, but exactly at that time an extremely good physician in Manchester saw a case with me, and had not the slightest idea of what it was. Dr. Dreschfeld saw it soon after, and agreed with me that it was alcoholic paralysis. I happened to know it because of Sir Samuel Wilks' account of the disease. All that proves that up to that time it was not described in the certificates.

397. How long have you been in practice or attached to the hospital at Manchester?—I have been in practice since 1885—18 years.

398. Apart from last year, do you think that cases had been increasing in frequency?—No, certainly not at the Manchester Infirmary, and from my general feeling not at Crumpsall. We have no figures for Crumpsall, unfortunately, but at the Manchester Infirmary certainly not.

399. Did you study medicine in London as a student?—No, in Manchester.

400. Have you any London experience?—No.

401. Because in the figures that you gave in, I think you said there were annually 1,500 medical patients in the Royal Infirmary at Manchester in the wards, and 20 cases of so-called alcoholic neuritis?—Yes.

402. That far exceeds what I think would be the figures in any of our Metropolitan hospitals?—That is to say, you think it is also more common in Manchester?

403. Much?—That is my feeling.

404. I have had 40 years' experience at Bartholomew's, and in a much larger number of patients than 1,500 medical patients in the wards we did not get three or four or five?—My statement about London was made on the strength of many conversations I have had with London physicians whom I have met from time to time in Manchester. I had no personal experience; it was simply a general feeling that I felt it was commoner in Manchester than in London.

405. You went on so far as to question whether there was alcoholic paralysis? Have you any doubt in your own mind whether there is alcoholic paralysis or not?—I cannot help but doubt, considering Sir William Gairdner's letter, as regards Scotland. The amount of alcohol *per se* that they take in Scotland is very great, and if with all his enormous experience he has seen so few cases, I cannot help but doubt that it is not due to alcohol *per se*. Of course I cannot say it is not due to some other impurity. I do not mean to say it has been always arsenic by any means.

406. That is what I wanted to elicit?—I should not like to go as far as that, but it certainly looks very suggestive.

407. But that there has been for long a form of peripheral neuritis and paralysis associated with the consumption of alcohol you have no doubt?—Not the slightest.

408. I should rather like to know whether it is your impression that probably the cases you saw previous to 1900 were arsenical?—I can only suggest that they were, simply from the extremely close resemblance of the symptoms and from the very fact which I mentioned that such good observers as there are in Manchester, Dr. Dreschfeld, Dr. Bury, and so, who were actually seeing these cases, never noticed anything different for a good three months. Dr. Dreschfeld noticed that some of them were peculiarly dark, but even that did not draw his attention to the fact that there was any difference in the paralysis, which shows that there was no difference. The cases went on, and everybody thought, as a matter of fact, that it had something to do with the increase in drinking. They assumed that people were drinking more because of the war, for some reason or another. But the character of the paralysis did not suggest to them that there was anything different.

409. But the cases previous to last year did not have the skin affections, did they?—Yes, some of them did. The other day I looked up the late Dr. Ross's account. He was writing this account at the time I was resident medical officer at the Manchester Royal Infirmary, and in this account it is most curious how he describes many of the patients with the redness of the hands and feet and the profuse sweating of the hands and feet, and in

some cases he mentioned the thickness of the soles of the feet, so that there had been skin eruptions in some of these so-called alcoholic cases.

410. (*Dr. Whitelegge.*) And pigmentation?—No; I do not know.

411. That is new?—That is new. I should like to put the pigmentation rather before May. I think even at the beginning of last year my assistants at Crumpsall on one or two occasions asked me to go to a particular case because they thought they had a case of what is called Addison's Disease. I was asked to see the cases. In none of the case of so-called Addison's Disease was I able to satisfy myself that it was Addison's Disease. I said I did not know what it was, but it was not Addison's Disease. That was before May. I am inclined to think it was February or January. They were all heavy drinkers.

412. (*Chairman.*) January or February, 1900?—I think so.

413. (*Sir William Church.*) But you are clear in your own mind that, although there were some skin affections, those we have been accustomed to in alcoholic paralysis, at all events there was no pigmentation before 1900?—Yes.

414. You said that a very small amount taken continuously, you thought, might produce peripheral neuritis. What is your ground for thinking that, other than what you have seen lately?—That, as I said, was merely a suggestion. My ground for thinking it is this, that arsenic seems to have such a peculiar susceptibility to seize certain tissues, particularly tissues containing keratin, and after the suggestion made by Dr. Dixon Mann the other day, pointing out how much keratin there was in the nerve tissues, it struck me: Was it not possible also that arsenic, which when taken in comparatively small doses can be found in the hair, in the scales of the skin, and in the nails, might be also found to cause neuritis? Quite minute doses of lead taken for long periods, without causing any of the acute symptoms of lead poisoning, will cause paralysis, and I asked myself whether it was not possible for arsenic to do the same thing.

415. Have you ever known any symptoms like these to arise, in the course of your practice, in skin diseases where arsenic is given for a very long period?—I have seen pigmentation on one or two occasions. I have seen two cases, one a woman who had slight pigmentation and slight paralysis of the hands—I think it was a case of Dr. Ross's; and the other was the most marked case I have ever seen, a girl I saw in consultation, who had had a plaster applied to a tumour on her back, in Ireland. She was brought to England paralysed, and I was asked to see her, because it was supposed that this tumour had affected her spinal cord. She had pigmentation and typical arsenical paralysis, and that was merely from the application of an arsenical plaster to the outside skin.

416. (*Sir William Church.*) What was the date of that case?—Probably about 1896.

417. (*Chairman.*) Did she get well?—Yes.

418. (*Dr. Whitelegge.*) So that you recognised at that time that motor and sensory paralysis depended on arsenic?—Yes; the diagnosis was quite easy.

419. (*Chairman.*) Is it possible that the cases which surprised Sir William Gairdner may have been the result of arsenicated beer?—It is quite possible, but if so, it must have been in very minute doses, because otherwise they would have had some more marked symptoms than they had.

420. (*Sir William Church.*) You said that about 50 per cent. only had initial symptoms pointing to the digestive system?—I think it was about 50 per cent.

421. Vomiting and diarrhoea?—Either vomiting or diarrhoea, or both.

422. Did those cases become the worst ones?—I think perhaps, on the whole, they did. I never thought of it in that light before, but perhaps they did.

423. Ordinarily, when an overdose has been given medicinally or accidentally, those are the commonest symptoms of arsenical poison?—Exactly.

424. You could not say whether those that had vomited or had diarrhoea, or both, turned out to be generally the most severe cases,?—I think, on the whole, I can say they did—that they turned out the severer cases. And yet not always, for this reason, that some of them who vomited and had diarrhoea had the good sense to at once change their liquor. That was given

Dr. F. S. Reynolds.

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Pigmentation.

Arsenic and keratin.

Gastro-intestinal symptoms in the epidemic.

Dr. E. S.
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to me as a reason on several occasions. They said the beer was not agreeing with them, and they had been taking spirits. Some of them came to the out-patients' room of the infirmary, and I told them at once when I saw their faces that they had been drinking beer. Some denied it so emphatically that they made me think I had made a mistake, but on sticking to them and pressing them to tell me everything they admitted it. They at first said they were spirit drinkers, and when I asked them how long they had been drinking spirits, they said they had been drinking them for about a fortnight, and drank beer before. Then I have asked them why they have stopped taking beer, and they said because it did not agree with them. That history was given me in one or two cases.

425. In your experience there had been more men affected, although not so severely affected, than women?—I have seen more men.

Incidence on
sex.

426. Dr. Tattersall's experience was rather the reverse; there was not a very great difference between the numbers affected; but like yourself, there were many more deaths in women. Have you any explanation to offer as to that?—The point is this. The men came with quite slight symptoms. If they had simply tinglings in the hands and feet they came at once to the out-patient room. Those would not be the sort of cases Dr. Tattersall would see. He would have seen quite the worst cases—patients lying at home paralysed. But I saw men who were suffering from quite slight symptoms, and certainly they came in larger numbers than the women. Proportionately to the number of women drinking as compared with the number of men drinking, speaking without any proof, I should be inclined to think that the percentage of women affected was greater than the men. The actual percentage of drinking women as compared with drinking men is not quite so great. You see the difference in the figures.

427-8. 263 and 171?—Yes. I do not know what the normal rate of beer drinking amongst men and women is, but if we knew that one could get a percentage. I am inclined to think that the percentage rate amongst beer drinkers has been greater among women, although the actual numbers have been greater amongst men.

429. You have no evidence that arsenic, when given intentionally, affects one sex more than the other, have you?—No; except, curiously enough, the only three cases I have seen have been in women. I saw a case last week of a nurse who had the symptoms. She was a nurse at Crumpsall, and much to the amusement of her fellow-nurses she had these symptoms, but to a very slight degree. I went to see her last week, and asked her if she had not been taking some medicine on her own account, and she said she had. She told me she had been taking medicine that some patient was taking in one of the wards as a tonic. I sent for the medicine, and found it contained 1-20th of a grain of arsenious oxide in a dose, 5 minims of liquor arsenicalis. She had taken that for a fortnight.

430. I ask you as a result of your former experience, had it ever crossed your mind that one sex was more liable to suffer from medicinal doses than another?—No; I don't think it has.

431. In the fatal cases you say they usually died from heart failure?—Yes, generally.

432. What was the condition of the heart?—In some cases the heart muscle was fatty and the heart cavities dilated.

433. You mean that it was fatty degeneration?—Yes.

Toxic effect
of arsenic in-
creased by
alcohol.

434. (Dr. Whitelegge.) Do you think that alcohol is a predisposing cause to arsenical mischief?—Yes, I think so, because the medicinal dose that one generally gives without alcohol certainly has not seemed to produce these symptoms, although they have been apparently as large as those in beer. Therefore I am inclined to think that the alcohol in some way helps the arsenical symptoms to develop.

435. They may be parallel forces acting together?—Yes.

436. Is alcoholism regarded at all as contra-indicating arsenic?—I never looked upon it as such before.

437. Have you found from the history of the patients whom you have seen in this epidemic that they were generally in a weak state of health before the arsenical mischief began?—No; many of them were quite robust individuals.

438. The suggestion has been made that pigmentation in these cases was associated more with moderate drinking than with heavy drinking?—I should not think so.

439. You have spoken of the cumulative effects of arsenic. You would not think that deposit in the epidermis, the hair, and the nails, was a storing up in the same sense as the storing up in the case of lead, would you? It would hardly come back again into the circulation in those cases—so to speak, it is practically eliminated?—Yes; it would not come back again.

Dr. E.
Reynolds,

22 Feb.

Eliminat
of arseni

440. The storing up you meant was a deposit in some tissue inside the body?—Yes.

441. Do you know of any experiments on animals throwing light upon this question?—No.

442. In the figures you gave us for Crumpsall and Crumpsall the out-patient department of the Royal Infirmary, were there equal facilities for each sex? Was there, for example, in the case of Crumpsall a larger provision for male patients than female patients, or vice versa? Was the way open for all those of either sex who would naturally present themselves to come into the Crumpsall wards?—Yes.

443. There was no exclusion?—None whatever. There were plenty of beds on both sides.

444. Has any attempt been made at Crumpsall or elsewhere to obtain figures as to the consumption of beer by people of the same class, apart from the neuritis cases?—I don't think so. Do you mean the normal consumption of beer?

445. Yes, a control experiment as it were?—No, I do not think so. Many of these people spoke quite freely to me about it, and told me what their general beer drinking habits were.

446. You are referring to the patients?—Yes.

447. I meant those who were not patients—there is no standard or datum to go upon?—No, I have certainly not got any other figures.

448. Is there anything else you could suggest that would amount to predisposition to arsenical poison? Do you attach any importance, for example, to the suggestion of influenza or other influences of that kind?—Certainly not to influenza. In fact, during the last four months we have had less influenza at Crumpsall than we have had for the last ten years at the same time of the year. In fact, we have hardly had any. During the last ten years we have always at this time of the year had many cases.

Epidemic
related to
influenza

449. That would rather point to improbability of arsenical poisoning predisposing to influenza. There was no special prevalence of influenza before the epidemic began?—No.

450. Nor was there any special incidence of neuritis upon those who had suffered from influenza?—No.

451. I am not sure whether you have given us any figures showing the duration of the fatal cases?—I am afraid I have not got them, but I could get them if you wish for them.

452. Would all the patients in Crumpsall be of the poorer class?—Yes, quite the poorest class.

Class of
persons
attacked

453. Have you any knowledge of a comparable kind with regard to peripheral neuritis in the upper classes?—Only from my own private work, and I have no family practice, so that it is a little difficult for me to say anything of that.

454. Probably you would hear about it from practitioners?—Yes, but there has not been much, or comparatively little.

455. The main incidence has been on the poorer classes?—Yes. I have seen one or two cases amongst the middle class, but certainly it is principally amongst the poorer classes.

456. You referred to some cases in Paris in 1823. Was Paris there any suggestion there that there might have been epidemic arsenic?—Certainly not.

457. Were there any circumstances pointing to arsenic?—Not the slightest, but the description exactly tallies with the description of arsenical poisoning as seen in the recent epidemic.

458. But where there are cases of alcoholic paralysis you would now be inclined to suspect arsenic?—I should be inclined to suspect it, but I should not feel inclined to go any further.

459. (Sir William Church.) With regard to the mental condition, was there any difference in the mental condition of the patients during the last few months and those which you were accustomed to see in previous years?—Not the slightest. It was exactly the same kind.

Mental
symptom

SECOND DAY.

AT WESTMINSTER PALACE HOTEL.

Friday, 1st March, 1901.

PRESENT:

The Right Hon. LORD KELVIN (in the Chair).

The Right Hon. Sir WILLIAM HART-DYKE.
Sir WILLIAM CHURCH.
Professor THORPE.

Mr. COSMO BONSOR.
Dr. WHITELEGGE.

Dr. BUCHANAN, Secretary.

Mr. JAMES NIVEN, called; and Examined.

Mr. J. NIVEN.

1 March 1901.

460. (Chairman.) I believe you are the Medical Officer of Health for the City of Manchester, and you have lately presented a report to the town council on arsenical poisoning in the city?—That is so.

461. And you give evidence with regard to the recent exceptional sickness in the City of Manchester attributable to poisoning by arsenic?—Yes. The evidence which I have to give on this subject is derived partly from observation of cases in the union infirmaries and elsewhere, but mainly from a circular which was sent out to all the medical men of the city on the 27th of November.

462. This is a copy of the circular you sent out?—Yes.

463. And from the answers to this circular you derived a considerable amount of information?—That is so. The number of circulars sent out to medical men was 358, and the replies reporting cases were 124. The replies from medical men who had no cases were 49; that is to say, that somewhat over one-half of the whole of the medical men of the city did not send any reply to the circular—185 sent no reply. I know, from personal knowledge, that one or two men had a number of cases, and I infer from the districts in which they lived that, at any rate, a fair number would also have cases of this poisoning.

464. Have you any reason to suggest why they did not reply?—Pressure of work, simply. Many medical men have such an immense amount of work that they are run off their feet, and quite tired out in the evening, and I presume they did not feel equal to sitting down and replying accurately to a document of this description. I can quite understand it.

465. May it have been in private practice that some of the medical practitioners did not wish to reply?—I do not know that one would like to draw inferences of that description. I have in my mind one gentleman in particular who I know would not be deterred by that reason, and he did not send an answer. It is possible, of course, but I should not like to say that that was the principal reason for not answering the circular. I have made a summary of the number of cases which were reported in that way by the medical men of the city, and I find that those reporting cases without any qualification whatever reported 1,534 cases.

466. Without qualification?—That is to say without stating either that the cases were the severest cases or that they were not the severest cases. Those who qualified their cases, nearly all of them in the direction that they were only giving the severest cases, reported 240. The number reported by Union District officers was 254, and the number of medical men who reported large numbers of cases was nine.

467. (Dr. Whitelegge.) Reported that they had large numbers?—Yes, that they had large numbers of cases.

468. Without giving details?—Yes, without giving the details. I have put that down in round numbers as, say, 250.

469. (Chairman.) Were those who had large numbers to report in any special line of medical practice?—No, not all of them. One of them was a Union District officer. Those of them who reported in that way were people who had large practices amongst the poorest classes, or who were officers of public institutions. One or two were medical men having large practices among the poorer people. The numbers reported as in the union infirmaries, Crumpsall, since October—I take the

latest number given by Dr. Reynolds to this Commission—was about 400. The Chorlton Union Infirmary estimate was 200, of whom there might be 160 Manchester patients. The total is 2,828. From these I propose to subtract 552, made up in this manner: 100 patients at public institutions, such as the infirmary, coming from outside Manchester, the whole of the 254 reported by Union District officers, as it is just possible that all of them might afterwards have been taken into the Poor Law union infirmaries. We found there were 550 in the Poor Law infirmaries, and subtracting 254 we get 296 cases remaining. I propose to take off one-half of these as possibly included in the returns from practitioners who are not district officers, and who may subsequently have gone into the infirmaries. I propose to take off 50 cases as possible duplications at institutions. That leaves 2,276 cases reported as suffering from peripheral neuritis or arsenical poisoning. Almost all seem to be within the last six months, though not quite, because a few were reported in earlier months. One may, of course, allow for a margin of error, but if one takes into account the large number of medical men who did not report, I think it is quite safe to say that at least 2,000 cases must have occurred in the city within the last six months.

470. Have you reason to distinguish between peripheral neuritis due to arsenical poisoning and other causes?—That is a very large question indeed. There are a very large number of causes which give rise to peripheral neuritis. The reason that one looks upon all these recent cases, or the great majority of them, as having been due to arsenical poisoning is partly the short period within which the illness has begun. It has not been a gradually dawning illness, but an illness marked by a somewhat definite onset, and those cases have been all associated with the drinking of beer or stout. When I say all of them, I mean all of them with slight exceptions, say one or two cases, that may be neglected, considering how likely it is that a certain number of people will not admit that they have been taking beer or stout. Taking these things into consideration, one regards, at all events, the recent cases of peripheral neuritis as mostly due to the influence of arsenical poisoning. There has been no other cause at work which one is aware of. Other causes have formerly been at work, such as poisoning by bi-chromate of lead, to a very limited extent in one works; poisoning by bisulphide of carbon in another works. That, again, was extremely limited. During the influenza outbreak a certain number of cases of peripheral neuritis were ascribed to that disease, but on this occasion there has been no disease to which one could assign these cases of peripheral neuritis. There has been nothing which would induce one to think that they were not due to arsenical poisoning except only the continuous habit of drinking large quantities of beer or stout. That is to say, the only other case which one could think of in connection with the cases was alcoholic poisoning. The question has arisen lately how many of these cases of so-called alcoholic neuritis may have been formerly due to the effects of arsenic.

471. Previous cases?—I do not think it is necessary to go into that question, because the main element here is the enormous number of cases which have been observed within a limited period, the origin of which has been recent, and which, therefore, are, to a certain extent, unlike alcoholic neuritis, in which the progress of the case is slower. I do not say that as an absolute distinction. It is extremely difficult to make a precise and

Peripheral
neuritis and
arsenic.

Mr. J. Nisbet

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clear distinction between peripheral neuritis due to alcoholic poisoning and peripheral neuritis due to arsenical poisoning. Indeed, many practitioners in the earlier stages of this no doubt (I know some did, and I have no doubt many others) looked upon these cases as alcoholic cases. There have been in a number of the cases certain phenomena which have clearly marked them out as due to arsenic, or, at all events, which has marked out the patients as suffering from arsenical poisoning, the principal features of that nature being pigmentation of the skin and certain very distinctive rashes. There is also another feature which, however, has not been until recently worked out, viz., an extremely horny condition of certain parts of the skin, especially the hands and feet. It has been found by different observers that the horny cuticle is very rich in arsenic, which, of course, proves that these conditions were due to arsenical poisoning. These are the main conditions which have pointed definitely to arsenic, but these conditions have been present only in a portion of the cases and not in all of them. The wasting, profuse sweating, and other symptoms which are common to alcoholic and arsenical poisoning have been present also in these recent cases, without the pigmentation and without the arsenical rashes; so that it is largely by inference that one regards them as due to arsenical poisoning.

472. Do you consider that there is good reason for believing that in a very large proportion of this 2,000 cases the illness has been due to arsenic?—Yes. I put it at as low a figure as possible. I think one may regard that as the minimum estimate of the number that have actually suffered from symptoms of arsenical poisoning.

Peripherals
neuritis in
Manchester
before 1900

473-4. Is there information as to the number of deaths from peripheral neuritis and from other neuritis and from chronic alcoholism in the City of Manchester during the past five years?—Yes; I present a table showing for each week during the last ten years, that is to say, from 1891 to 1900 inclusive, the deaths registered from peripheral neuritis, other neuritis, alcoholism, cirrhosis of the liver, other liver disease, and gastritis in adults, and the total number from all these causes. (See Tables A and B of Appendix No. 3.) This table shows that death from peripheral neuritis and from other neuritis have been increasing in number since 1896, and that the number of deaths from chronic alcoholism and from cirrhosis of the liver has fluctuated from one year to another, but that from each of these causes of death a great increase has occurred in the year 1900.

475. (Dr. Whitelegge.) Would not your table rather show the increase of cases commencing earlier in 1893? I was going to come to that. The latter part of the table was only prepared in the first instance, and the first five years is supplementary. The first marked increase in peripheral neuritis is in the year 1893. In 1891 the deaths were 8; in 1892, 9; in 1893, 14; in 1894, 17; and in 1895, 17.

476. (Chairman.) Are those deaths from peripheral neuritis?—They are simply from peripheral neuritis. In 1896, 14; in 1897, 13; in 1898, 19; in 1899, 20; and in 1900, 48.

477. That is more than in any previous year?—A very great increase indeed upon previous years. The first increase took place in 1893. Then there is not any decided continued increase until the year 1900, when the number of deaths springs up very suddenly from 20 to 48. Without reading the figures again, the same thing is observable under "neuritis." There is a very remarkable increase from neuritis in the year 1893 from two in the previous year to ten, and again from five in 1899 to twelve in 1900. There is no doubt that the increase in the last year is due to arsenical poisoning, but it is not so easy at this point of time to account for the very marked increase in the year 1893. I have considered the various causes as well as I could which could have occasioned that increase, but I am not able to account for it.

478. (Professor Thorpe.) You mean in 1893?—Yes, in the year 1893.

479. (Mr. Cosmo Benson.) Were you medical officer in 1893?—I was not; but of course I have all the records. There was in 1893 no outbreak of disease which would give rise to a large amount of peripheral neuritis—no outbreak of diseases known to be causes of peripheral neuritis.

480. (Chairman.) Or other neuritis?—Or other

neuritis. Moreover, it is true that a great deal of discussion in the medical papers had taken place with regard to alcoholic neuritis, but that discussion took place chiefly in 1899, and went back as far as 1886. It may be that medical men were getting educated, but that scarcely seems to account for it, because if that were the cause there would not be the subsequent drop.

481. (Sir William Church.) When did you first make use of the term "peripheral neuritis" or "neuritis" in the registration of deaths in Manchester?—I am not able to tell you that, because our records do not go back.

482. It was only introduced into the official nomenclature of diseases in 1895, and it took some time before the profession became thoroughly conversant with the new additions to the nomenclature of disease?—Yes. I say that is the cause which presents itself as a possibility. It is singular, however, that it should take such a sudden ascent in one year. It is not a gradual ascent such as you would expect from the effects of education; it is a sudden ascent, which is only barely maintained in subsequent years, or is not maintained.

483. The fact of there being, as you mentioned that there was, a good deal of discussion going on in the medical journals would perhaps have a greater effect than the mere alteration in the official nomenclature?—I think it would; but then that discussion was prior to the years 1891-2, and it is singular that it did not have more effect upon the nomenclature in those years.

484. (Professor Thorpe.) Was it a period of inflated Sligh trade, or were there any economical questions such as increased wage-earning, which might possibly account for it in 1893 or just immediately prior to 1893? Was Manchester at that time particularly well off, as far as trade went?—That I cannot tell you. From the table handed in you will see that in 1893 (it is a singular thing, and I do not want to lay too much stress upon it) the deaths seemed to be grouped together somewhat from the 26th to the 36th week. No fewer than seven out of fourteen occurred in these weeks.

485. (Chairman.) Fourteen weeks of the year 1893?—No; eleven weeks of the year 1893 after the cases occurred.

486. (Professor Thorpe.) What months would that be?—The 26th is midsummer, of course.

487. It would be from the summer to the autumn of the year?—It would be in June, July, and August, the hot months of the year.

488. A period of the year, too, when the operative class would be taking such holidays as they would get?—Yes, that would be so. But it is singular that it is not so in other years. It is very striking in that very year the way in which the deaths are grouped together.

489. (Sir William Church.) The total deaths in that year is the heaviest, too, from these different causes, 236, and the next highest is 223, only a slight difference, but it is one?—Certainly, that is also so.

490. (Chairman.) In 1893 there was also a slight increase in alcoholism, but not so great an increase as in alcohol neuritis and peripheral neuritis; and I see that there was an increase of alcoholism in 1900 from 81 the year of the before to 109?—There is an increase in everything connected with alcohol in the year 1900, an increase under alcoholism and under cirrhosis of the liver; a very marked increase.

491. (Chairman.) Is there any probable explanation of that?—I go on to say that this increase is most marked in the last half of the year 1900 from all these causes, and in the case of peripheral neuritis it is confined to the last half of the year. In the last twenty-six weeks of the year 37 deaths are registered from this cause, peripheral neuritis, as against eleven in the first twenty-six weeks of the year. From cirrhosis of the liver 75 deaths were registered in the second half of the year, as against 51 in the first half of the year. From chronic alcoholism, again, 66 deaths were registered in the second half of the year, as against 43 in the first half.

492. A large increase in the second half?—Yes, from all these causes. That arsenical poisoning has in each instance had to do with this increase is certain. That it is responsible for the whole of it can only be determined by the study of the Revenue returns, which will

show whether there has been a great increase of drinking during 1899 and 1900. I mention 1899 because I take it that alcoholic poisoning is a very much slower process than arsenical poisoning, and therefore it would be necessary to go back to 1899 to study the Revenue return in that year as well as in 1900. If it can be shown that this increase in drinking did occur, arsenical poisoning will not be excluded, but it will not be possible to regard it as the sole cause of the increase in the number of deaths.

493. (*Professor Thorpe.*) Arising out of that answer, supposing it is the fact that the Revenue returns did not show that there was any great increase of drinking in Manchester and the neighbourhood during 1899 and 1900, what would be your inference then?—That these deaths were largely due to the effects of arsenic. That arsenical poisoning was going on to a large extent is quite certain from the increase in peripheral neuritis and neuritis. There can be little doubt about that, because those are the features especially associated with arsenical poisoning. With regard to chronic alcoholism, as I have already mentioned, there is good reason for believing that the medical men regarded the increase of these cases at first as really due to alcohol, and they would not be unlikely in the case of people who drink a great deal to put down the deaths to chronic alcoholism and not to the specific cause of the other symptoms. With regard to cirrhosis of the liver, that is really a somewhat difficult term to define; but cirrhosis of the liver is defined medically for the purposes of registration, I take it, by some change in the condition of the liver, partly by a certain group of symptoms, and very largely by the occurrence along with certain diseased states of the liver, of ascites, of a collection of fluid in the abdomen. The recent cases of arsenical poisoning have certainly been associated (I do not now speak from my own observation), as is stated by the best observers, with a considerable amount of effusion of liquid in the abdomen, what is called ascites. Dr. Reynolds, who has given a great deal of study to this subject, has found that in a very large proportion of these cases what is called hypertrophic cirrhosis of the liver, that is to say, cirrhosis of the liver, with enlargement and softening is present in these cases.

494. (*Sir William Church.*) Is not that rather an unusual thing in cirrhosis arising from alcoholic excess? Where you get cirrhosis and ascites is it usually hypertrophic cirrhosis or is it not rather a different form?—I understand it is the experience of the medical men in Scotland that they only get exceptionally this form of cirrhosis of the liver, and that when they do get it it is associated with beer drinking. I believe this form of cirrhosis is exceptional with the drinking of spirits. That is what I understand, but this is mere current talk on the subject. There is no specific statement on the subject that I know of except this, that experiment with animals shows that cirrhosis of the liver is not produced by ethylic alcohol or ordinary spirits. Of course that somewhat increases the probability that when you get cirrhosis of the liver associated with alcohol it is due to some irritant matter in the beer other than the alcohol.

495. My point is, is it not your experience of the profession in Manchester that the cirrhosis of the liver which leads to ascites and eventually to death perhaps, is usually of the contracted form and that there has been in the fatal cases in this epidemic an unusually large number of the hypertrophic form?—I cannot speak to that. I have had no personal experience or very little personal experience of practice in Manchester. That I cannot say. I have not in Manchester seen a single case of cirrhosis of the liver until this outbreak, but my former experience certainly was that the cirrhosis of the liver which I have seen in London and elsewhere associated with alcohol has not been of that hypertrophic character.

496. (*Dr. Whitelegge.*) Do you think of the hypertrophic kind as being associated with spirit or with beer?—With beer and not with spirit.

497. Are you thinking of it as being of rapid causation?—Do I regard it as probably of rapid causation?

498. Yes?—I should say so, but this is a little outside of my line, of course.

499. Still you have brought the medical opinion very conveniently before us?—I have followed the medical opinion on the subject, and I believe that is the medical opinion on the subject, that arsenic will

of course, cause a fatty condition of the liver. How far it causes the cirrhosis is another matter. Although I have seen it stated in a medical paper that Brouardel associated cirrhosis of the liver with the effect of arsenic alone, apart from alcohol. I have not seen the original papers of Brouardel, and I can only say that I have seen that stated in a medical paper.

500. (*Sir William Church.*) The point is, and that you are clear of from what you have learned from the medical practitioners in Manchester, that many of these fatal cases of cirrhosis of the liver were of the hypertrophic form?—I have not learned that from medical practitioners but from Dr. Reynolds. I have no other authority. That is the result of his experience alone.

501. (*Chairman.*) In one of the answers you just gave you distinguished between spirits and beer. Was that opinion formed before the recent outbreak?—It was not formed by me. It is difficult to speak of another man's views, but Dr. Reynolds, I believe, has consistently maintained that peripheral neuritis at all events, was caused by beer drinking, and not by other forms of alcohol.

502. We have had Dr. Reynolds' evidence before us, and you may take it before the recent outbreak he had formed that opinion?—Long before the recent outbreak he, at all events, had formed that opinion, that is quite certain.

503. (*Sir William Church.*) Although you speak in your *précis* here of chronic alcoholism, you in your table speak of alcoholism; would that include acute alcoholism?—Yes.

504. Has there been a great increase of cases of delirium tremens in Manchester during the last year?—No; a great many of the practitioners did make remarks upon the returns which were sent in, but not one has mentioned that delirium tremens or acute alcoholism has come within his observation. Many of them stated that the patients who suffered were heavy drinkers.

505. And there has not been an increase in the number of deaths attributed to acute alcoholism, which means delirium tremens?—The return has been compiled simply as alcoholism, and I could not answer that question without going back over the register.*

506. But the return of alcoholism would include any incidence cases of that sort?—It would. From the analysis of sex, the deaths in age and sex groups, it will be seen that women died to a much greater extent than men from neuritis, with a tendency to die earlier. What might be the precise meaning of this it is somewhat difficult to say. Probably it is due in the main to the more sedentary life which women lead. It is difficult, I think, to believe that women drink more than men, or as much. It is certainly perfectly clear from observations which have been made that arsenic is largely eliminated by the skin, and I think it is probable that a great deal of the arsenic imbibed by a man is worked off in the course of his labour.

507. (*Chairman.*) So that a labourer might drink more arsenicated beer without the worst results than a woman not working in that way?—I think so. I think that is one of the explanations why the arsenic

* *Note by Witness.*—The annexed return, made from the death registers, gives the information asked for in Question 505.

YEAR.	Chronic Alcoholism.	Alcoholism.	Acute Alcoholism	Inquest Certificates.	
				Excessive Drinking.	Delirium Tremens.
1891	12	12	1	37	15*
1892	6	13	1	33	3
1893	9	17	-	47	5
1894	16	20	-	29	7
1895	6	14	-	27	8
1896	6	11	-	42	5
1897	18	26	1	25	4
1898	2	24	-	20	2
1899	10	28	1	40	
1900	19	49	1	33	

Five of these certified alcoholic mania.

Mr. J. Niven. has affected women to so much greater an extent than it has men.

1-Mar. 1901.

508. (*Sir William Church.*) Since we have been acquainted with what we have termed alcoholic neuritis, has it not been found to be the case, that there are more fatal cases proportionately among women than men?—Yes; that is clearly brought out—

509. I mean before this group of cases entirely, going back a good many years?—Yes. This table which I hand in is going back ten years.

510. So that the fatality among women in this epidemic has adhered to the old rule that these cases are more fatal in women than men?—Yes; that is very clearly brought out. You will see that women tend to die somewhat earlier than men.

511. (*Chairman.*) That is of neuritis?—Yes, of neuritis, simply from this cause. Then, of course, in women a smaller quantity of arsenic with the smaller frame of women would produce a greater effect, weight by weight.

512. (*Dr. Whitelegge.*) With an equal consumption?—Yes. That is to say, the same amount of arsenic will certainly produce on the average a greater effect upon women than upon men.

513. (*Sir William Church.*) What makes you say that?—Simply because they are lighter, as a mere matter of animal weight.

514. Granted that; but when used in medicinal doses, has that observation ever been made?—I do not know that it has, but we are now speaking of arsenic that we see to produce poisonous effects. When you find you are actually getting poisonous effects it is clear that a smaller amount will produce the same effect in women as in men on the average from their smaller frames. Then I think it is probable, although that would need some extensive observation, that the drink of women is more exclusively beer and stout than that of men. I think men, in addition to their beer, or perhaps instead of it, will drink more largely of spirits than women, whereas the more habitual drink of the women will be beer. Anyone who is acquainted with the side streets of these large towns knows that it is the custom to send out for a pot of beer in the afternoon, and in some parts of the town women are in the habit of meeting and having a gossip over a pot of beer.

515. (*Dr. Whitelegge.*) At home; so that they would usually get their supply of beer from the same place?—Yes.

516. Would you attach importance to that as a consideration?—Yes; I think that is not immaterial; I think it is not altogether immaterial, though I think many of the men would resort to the same place also. I think the men would mix good beer with bad to a much greater extent than women would. I do not mean to say that this is a universal or general custom in the City of Manchester for women to drink like that, but it does unquestionably prevail in certain districts.

517. The cases are more fatal among women; can you tell us what are the number of attacks of women and men—have you the figures?—No; I have no means of giving those.

518. That was not one of the points of the enquiry?—No, that was not one of the points of the enquiry, I regret to say, and I have not that figure. The cases that we did collect I have given, though they cannot be supposed to bear on that. We collected histories of the illnesses of a series of 85 cases, out of which there are here details of age and sex in 77—35 men and 42 women.

CLASSIFICATION AS TO AGE AND SEX OF CASES OF ARSENICAL POISONING observed by the Medical Officers and others, whose symptoms have been recorded. In 8 out of 85 Cases the Ages have not been ascertained.

Males.				
20-29	30-39	40-49	50-59	60 and upwards
—	10	14	6	5
Total, 35.				
Females.				
20-29	30-39	40-49	50-59	60 and upwards.
1	17	14	9	1
Total, 42.				
Both sexes, 77.				

519. Those were selected cases, no doubt—not taken at random?—They were taken at random so far as going down the wards was concerned. There was no principle of selection, they were simply cases taken as they came. But that has no value, of course, for estimating the relative number of men and women affected. There is, however, this, for what it is worth, that the cases occurring among the 42 women between the ages of 30 and 40 were 17, and between 30 and 40 in men were 10, so that the whole difference was made up of the larger numbers of women between 30 and 40. The men at 60 and upwards number 5 to women 1; so that there again it would appear, taking these cases really unselected, that the women suffer at an earlier age than the men.

520. (*Chairman.*) The illnesses presented in this table were infirmity patients?—Largely patients from the union infirmaries, and some of them from our personal observations outside the unions; but most of them from the union infirmaries. They form, of course, a permanent record of these cases. The symptoms are not very exhaustive, but they do form a permanent record of these cases. Many of them suffered from perfectly distinctive symptoms of arsenic, and I have brought this record of the cases, which perhaps the members of the Commission may like to look at.

521. These, I suppose, are the cases to which you were referring just now?—Yes.

522. (*Chairman.*) The cases regarding which you have given information, the whole 2,000 in 1900, and the special cases, are chiefly cases of the poor treated in workhouse hospitals?—No; the number occurring in workhouse hospitals has been 550 out of 2,000, and the others would be largely poor people; but no doubt a number of them would be artisans.

523. I wished to ask that question?—Yes, respectable artisans.

524. Has this epidemic been largely prevalent among the class of respectable artisans, men employed on wages in factories, or in engineering works, or in any of the works of Manchester?—Yes; I think one may say there have been a good many cases either in men or women of that class. There is no doubt that that is so.

525. And labourers; navvies, for instance?—The labouring class, of course, have suffered more; that is, so far as the reports go. It is possible, however, that we get more information with regard to the poorest class of the population than we do with regard to artisans in a somewhat better position. I think it is likely that we do not know so much about them, but speaking from my personal knowledge of a practice of a friend, I should say we do get these cases occurring amongst the artisan class.

526. (*Mr. Cosmo Bonsor.*) Might not that be from the quality of the beer that the artisan class drink? They drink a higher class of beer, do not they?—Yes, largely.

527. It might be from that?—Yes; the better class people drink in the main a better class of beer, but I do not know that they all do. I think it is quite possible that those cheap beers are sometimes used as table beer by people in better circumstances.

528. Have exceptional sickness and deaths been due to arsenic in beer, or in other articles of food also, not solely to arsenic in beer, but to arsenic in other articles of food and drink?—The exceptional sickness and deaths noted have, so far as I can ascertain, been confined to adults, children having entirely escaped. I made particular enquiries at a very early period of the epidemic from the physicians at the Children's Hospital, and I am quite satisfied that no cases were taken there of children suffering from these conditions, nor have I heard of any children.

529. This goes far to exclude sweets, jams, breads, etc., as sources of arsenical poisoning?—Yes, that is found in quite clear. Of course, children partake more freely sweets, than adults of these materials. However, in addition, a number of samples of cheap sweets and jams have been examined for arsenic, but have been found free from it in any appreciable amount.

530. Do you think that a more extensive examination of sweets, jams, and marmalades should be made? We know that glucose is largely used in jams, for instance?—Yes, we have made fairly extensive examinations. The number examined by the public analyst was 25 jams and 25 sweets obtained from a great variety of sources, and in addition, I have also examined in my office 18 samples of jams and 21 samples of cheap sweets. So that a pretty large number of jams and sweets have been examined either by the public analyst or by ourselves.

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531. (*Dr. Whitelegge.*) Examined for arsenic?—Yes, examined for arsenic. I also examined three glucoses from manufacturers of cheap sweets and jams, two obtained on November 24th, and one on December 10th, the two being obtained at the very commencement, before they could well have removed anything.

532. (*Sir William Church.*) Were they free from any trace?—Yes, free from any trace of arsenic, so far as our examinations went.

533. (*Chairman.*) Is there any secret about the employment of glucose in jams and sweets?—None whatever. It is used in making honey, jams, and syrups. In fact, 9 samples of cheap syrups were submitted to the public analyst on the supposition that glucose was used in their manufacture, and all found free from arsenic.

534. (*Dr. Whitelegge.*) Did you go into the question of the origin of the sugar used in these sweets?—I did not. Of course, our time was very much taken up doing the analyses ourselves.

535. (*Chairman.*) Is there a possibility that there might be arsenic in bottled mineral waters, for instance?—That was mentioned. It appears that an acid phosphate is made by acting upon bone ash with sulphuric acid, which is used to flavour mineral waters. It goes by the trade name of phosphocitric acid; it is really phosphoric acid. It occurred to me that perhaps it was possible we might have overlooked something of the kind, but I am now satisfied that nothing of the kind occurred in Manchester, because I know the source of the bone ash and of the sulphuric acid, and I am quite satisfied that arsenic could not have entered into that material to a poisonous extent. Not only so, but naturally the amount of this material added to the mineral waters is small, so that a very large amount of arsenic would have to be present in the phosphocitric acid, a much larger quantity than is possible in the process of manufacture, before it could produce poisonous symptoms. I think that may be dismissed as a possible source, certainly as far as Manchester is concerned.

536. (*Chairman.*) Have ginger beers and lemonades been examined?—Yes; 22 samples of mineral waters were taken on January 21st and 22nd, and submitted to the public analyst for examination for arsenic.

537. Are ginger beers and lemonades included?—Yes, all the common mineral waters.

538. (*Mr. Cosmo Bonsor.*) Ginger ale?—Yes, ginger ale, and all the other kinds of mineral drinks.

539. Are they made from glucose?—Yes, glucose is used in the making of them. I was not thinking of that. These samples were taken simply with reference to this phosphocitric acid. At all events, they show entire freedom from arsenic.

540. (*Chairman.*) Have you any investigation of earlier samples than those referred to in the report that you now present, samples earlier than last January?—Not of mineral waters. I only learned of the possibility of this at a very late period, and I immediately requested that samples should be obtained. I admit that, even if it had been present, it would probably not have been found at so late a period as that.

541. You have no evidence of an earlier period?—I think we may conclude that it was not present in any marked deleterious quantities at any period, on account, principally, of the small quantity that could be admitted into the mineral waters.

542. (*Professor Thorpe.*) Perhaps you have learned from what has appeared in the medical papers that there have been one or two very serious cases of poisoning by medicated or aerated drinks, in which phosphate of soda has entered, which phosphate of soda has been found to contain arsenic?—I have not learned that.

543. I thought possibly it was that fact which had led you to go on and search mineral waters; but you were not aware of that fact?—I was not aware of that.

544. (*Chairman.*) So far as the observations made at the union infirmaries and other public institutions go, and so far as the testimony of Manchester practitioners go, may we take it that the symptoms of arsenical poisoning have been confined to persons drinking beer and stout almost exclusively of the cheaper qualities?—Yes, I say that the exceptions to this statement are trivial. In fact, I have only heard of two possible exceptions. One of these was associated with the drinking of a better class of beer, which I had the opportunity of analysing, and which presented the merest trace of arsenic. It was so small that it was impossible to determine the amount with the quantities used. The other

case that I have heard of was in connection with drinking *Mr. J. Niven*, wines of a better class.

545. Was arsenic found in the wine?—I do not know. I cannot speak as to that. I may mention that I have recently—February 22nd—obtained six samples of cheap wines, two of port, two of Burgundy, and two of claret, but have found no arsenic present according to the ordinary Reinsch's test.

546. Is there any explanation why it should be in the cheaper qualities of beer that arsenic is found?—Is glucose used in high-class beer?—Yes. That is due, no doubt, to the proportion of glucose which has been used in the production of this beer.

547. Is there a larger proportion of glucose in the cheap beers?—Yes, and invert sugars are also used in the production of this beer.

548. (*Dr. Whitelegge.*) Have you particulars of any case of peripheral neuritis in which there was no consumption of beer at all?—I believe in one of the cases there was something about that. It is page 19 of my report, No. 80 of the cases. The case is recorded in full in the papers I have just handed in. I am afraid I put no stress upon that. This patient was 47 years old. The notes are very scanty. The early symptoms of the illness were nausea, vomiting in the morning, pains in the hands and feet and on pressure of the calf, and slight difficulty in walking. The present symptoms, as observed by the physician at the hospital (this is Ancoats hospital) are that the patient has slight difficulty in walking, dilatation of the right side of heart, pain and redness in the soles of the feet, excessive sweating of the hands and feet, eruptions, slight ichthyosis, that is thickening of the skin, peeling, or desquamation of the skin. This patient denies having taken beer. I know the street in Ancoats from which this patient comes, and I think it would not be well to attach an undue degree of importance to the statement that this patient has never taken beer.

549. (*Sir William Church.*) Those symptoms are just the ones we used to attribute to alcohol; she apparently had no pigmentation, there was something of an eruption, but we are not told the character of the eruption?—That is so. Those are just the symptoms which were formerly ascribed to taking alcohol. I think in one or two isolated instances the statement that no beer had been taken should be received with great caution.

550. (*Chairman.*) Did this case end fatally?—No; she recovered, I believe.

551. (*Sir William Church.*) Was there a large number of cases of peripheral neuritis observed among the employés of the breweries in Manchester?—I believe so, but I do not know that of my own knowledge. I know it of one large brewery, because I had a conversation with the brewer upon the subject. This brewery, however, was not in Manchester.

552. One would rather expect that there should be a marked difference between the employés of the breweries that used a large quantity of the probably deleterious sugars, and those which used a less quantity. You would have thought their employés would have been the first people to suffer?—That depends very largely on the amount of beer they are allowed to take. In this particular brewery it was a very marked feature, but that, I think, you have probably already had.

553. Do you mean the amount of illness?—In one particular brewery, not a Manchester brewery.

554. (*Sir William Church.*) We have not had any evidence yet associating outbreaks of the disease with breweries so far as their employés are concerned?—Well, I believe that in one brewery a number of workmen did have symptoms of arsenical poisoning.

555. (*Dr. Whitelegge.*) Have you the particulars of the employment of the men who suffered from this? Shall we find in the notes you have brought to us particulars of the employment?—No. Of course, so far as the deaths are concerned, I think it could be easily obtained. I have handed in the paper of additional statistics of the deaths, and if it is not upon that list it could very easily be obtained. (See Appendix, No. 4, Table D.) May I say that my efforts, so far as they concern investigation in this matter, were directed to determining whether the poisoning arising from the consumption of beer and stout was due to glucose and invert sugar from which it was made, or whether it was due to other ingredients in the beer, and that the notes which I have brought were collected, arranged, and classified mainly with that object.

Mr. J. Niven. 556. (Chairman.) In many cases you have been able to trace the beers habitually used by the patients to the breweries producing them?—Yes, a very large number of these people got their beer, or most of it, habitually from one place, or if not from one place, from two or three places. Sometimes, of course, they used a great deal at their work, and then they go to a particular place, or they have a good deal at home, and they have another place. We obtained from each patient visited a statement of the public-house or public-houses from which their beer was obtained, and what particular kind of beer they used. In a number of instances the patients were able to tell us what precise brewery it was that produced the beers they used, but in a number of

others all they could tell us was the kind of beer and the public-houses which they frequented. In those instances the Inspectors of Food and Drugs visited the public-houses, where necessary, and ascertained the precise beer which had been consumed, so that in 63 out of the 85 cases collected we were able to ascertain exactly what brewers the beers and stouts which these patients habitually consumed came from.

557. Had the brewery in each case used Bostock sugar?—Yes. I have constructed a table, which is on pages 16 and 17 of my Report to the Sanitary Committee of the Manchester Town Council, which you have before you, showing the connection of the cases with the sources of arsenical poisoning.

SUMMARY of 85 Cases, showing their connection with sources of Arsenical Poisoning.

No. of Case.	Beer subsequently taken from public-house frequented, shown to contain arsenic.	Sugar obtained from brewery, whose beers were consumed by the patient, proved to contain arsenic.	Arsenical sugar supplied to brewery, the beer from which was used.	Beer from the same brewery obtained at public-houses shown to contain arsenic.
A.	C.	C.	B.	
1	—	—	+	+
2	—	—	+	+
3	—	+	+	—
4	—	—	+	—
5	—	—	+	—
6	—	+	+	+
7	Name of brewery not obtained.			
8	Do.			
9	Do.			
10	—	+	+	
11	Name of brewery not obtained.			
12	—	+	+	+
13	—	+	+	+
14	Name of brewery not obtained.			
15	—	+	+	+
16	—	+	+	+
17	Name of brewery not obtained.			
18	General drinker.			
19	Patient moribund.			
20	Brewer not ascertained.			
21	—	+	+	+
22	—	+	+	+
23	—	+	+	+
24	Brewer not ascertained.			
25	—	+	+	+
26	—	+	+	+
27	—	+	+	+
28	—	+	+	+
29	—	+	+	+
30	—	+	+	+
31	General drinker.			
32	—	— in part	+	+
33	General drinker.			
34	—	— + + —	+	+
35	General drinker.			
36	—	—	+	+
37	—	+	+	+
38	—	+	+	+
39	—	+	+	+
40	—	—	+	+
41	—	+	+	—
42	—	+	+	+

No. of Case.	Beer subsequently taken from public-house frequented, shown to contain arsenic.	Sugar obtained from brewery, whose beers were consumed by the patient, proved to contain arsenic.	Arsenical sugar supplied to brewery, the beer from which was used.	Beer from the same brewery obtained at public-houses shown to contain arsenic.
A.	C.	C.	B.	
43	—	+	+	+
44	—	+	+	+
45	General drinker.			
46	Do.			
47	Brewery unknown.			
48	—	+	+	—
49	—	—	+	+
50	General drinker.			
51	Brewer not stated.			
52	—	+	+	—
53	Brewery not stated.			
54	—	—	+	—
55	—	+	+	+
56	—	—	+	+
57	+	+	+	+
58	+	—	+	+
59	+	+	+	+
60	+	+	+	+
61	—	+	+	—
62	—	+	+	+
63	—	—	+	+
64	Brewer not ascertained.			
65	—	+	+	—
66	—	+	+	+
67	—	+	+	+
68	—	+	+	+
69	—	+	+	+
70	+ very slight case	—	+	+
71	+ from brewer	—	+	+
72	—	—	+	+
73	—	—	+	+
74	—	+	+	+
75	—	+	+	+
76	—	+	+	+
77	—	+	+	+
78	—	—	+	+
79	—	—	+	+
80	— said not to have taken beer.	—	+	+
81	—	+	+	+
82	—	+	+	+
83	—	+	+	+
84	— brewery not known.			+
85	—	+	+	+

In the above table the sign + indicates that the presence of arsenic in appreciable amount was detected in the article named in the column under which it stands; the sign — that it was not so detected. When in any column there are two signs, such as — +, this means that the patient used two beers, and that of the materials in the column in one arsenic was not found, while in the other it was.

558. The breweries here are marked by letters, but the Commission would like to know the names of the brewers?—I have not the key here, but I can send the names to you.

559. Perhaps you will send the names to Dr. Buchanan?—I will send the names.

560. You have ascertained that the Bostock sugars were used in a considerable proportion of the Manchester breweries?—I ascertained that in every instance. From the list supplied to me by Dr. Tattersall, which

he obtained direct from Messrs. Bostock of Garston, I ascertained which Manchester brewers were obtaining their sugars, and in one case I ascertained directly at the brewery. I found that 12 out of 23 Manchester breweries had been obtaining Bostock sugars or inverts, and I found that in every one of these cases, which are recorded in that table, the brewery whose beers or stouts the patients had consumed had received the incriminated sugars or inverts—in every instance.

561. Is 23 the whole number of the Manchester breweries?—Yes, the whole number I have ascertained.

562. But there are more breweries than 23?—I think not.

563. There were 23 breweries and 12 out of the 23 had the incriminated sugars?—Yes.

564. (*Dr. Whitelegge.*) Are those 12 breweries in Manchester or supplying Manchester?—The breweries referred to as having furnished beer to 63 cases are not all in Manchester; two of them are not in Manchester. That would make 14 out of 25. There are two other brewers incriminated in this list.

565. (*Chairman.*) 14 out of 25; there being 12 out of 23 in Manchester?—Yes.

566. In those cases was beer from the same brewery obtained at publichouses other than those frequented by the patient found to contain arsenic in an appreciable amount?—55 out of the 63 beers taken either at publichouses supplied with the same beers which the patients consumed, or at the publichouses which they frequented, contained arsenic.

567. I think, having traced it to the brewery, you followed it back to the publichouses other than those frequented by the patient?—Yes, with the exception that in 7 instances the beer from the same public-house was followed up, and the beer was found to contain arsenic.

568. What was the highest amount of arsenic ascertained?—The highest amount which we have ascertained has been about half a grain per gallon. Perhaps you will allow me to explain precisely what steps we took which will lead up to a statement of these samples. The day after Dr. Reynolds informed me that arsenic had been found in beer, having ascertained from him the breweries from which patients were stated to have got their beer at the infirmary. I got 12 samples of beer taken and submitted to the public analyst. It was, however, some time before the Public Analyst declared the presence of arsenic in the beer, and meantime it had been discovered to be present in the glucose. A meeting of the Sanitary Committee took place on November 23rd, at which it was deemed advisable by the Committee to issue a public announcement that action would be taken in the case of any beers found in publichouses to contain arsenic. This announcement was, I presume, made in order that the publicans might have guilty knowledge of the presence of arsenic in his beer, so that he might be made aware formally and officially of the possibility that his beer might contain arsenic.

569. (*Dr. Whitelegge.*) Bringing him under Section 3?—That should, of course, have the further effect of bringing him under Section 3 of the Sale of Food and Drugs Act of 1875. After that we proceeded to take a number of samples, with the view purely of administration. 85 samples of beer were collected and examined by us, and of these 55 were found not to contain arsenic. That is a matter not very easy to settle if they do not show any trace of arsenic.

570. (*Chairman.*) By the Reinsch test?—In the preliminary stage of the Reinsch test, in the darkening of the copper. The darkening of the copper in the Reinsch test proves nothing, but the absence of it shows that arsenic is not present. In those that did darken further official samples were taken and submitted to the Public Analyst to the number, I think, of 27, and 26 of these have been declared by the Public Analyst to contain arsenic in the varying quantities.

571. (*Dr. Whitelegge.*) What was his report on the earlier samples?—Do you wish the exact amount?

572. Did the Public Analyst find arsenic in the earlier samples you submitted to him?—Yes, in 11 out of the 12. I will give you the full particulars of all the analyses which have been made.

573. (*Chairman.*) From these analyses, and from all the analyses that have come under your observation, do you find that large amounts of arsenic could only have been derived from the arsenical glucoses and inverts?—That is the conclusion to which one comes from the examination of those beers, and I may say also from subsequent published analyses of malts, and from the examination of malts which we have ourselves made.

574. Those cases were all taken after the 28th of November?—They were all taken after the 28th of November, after the Sanitary Committee had issued the notice.

575. Were the 81 samples taken after the 28th of November?—Yes, so far as our examinations go the particulars of these examinations are given at pages 28 and 29 of the Report which has been handed in.

4576.

576. Some samples, I see, were taken for another set of analyses about November the 20th?—Yes, the first set of samples were taken on the 21st of November. From these samples a number of summonses have been taken out against the publicans; I think the total number of summonses taken out has been 35.

577. (*Dr. Whitelegge.*) All against publicans?—Yes.

578. None against brewers?—I do not know that it was possible to take any other action.

579. (*Chairman.*) And have those summonses all had effect now, or are they pending?—Only one has been heard, and that summons is pending. The summons was taken out under Section 6 of the Food and Drugs Act, the charge being, "Selling to the prejudice of the purchaser beer not of the nature, substance, and quality demanded." The stipendiary magistrate, Mr. Headlam, gave his decision in favour of the Corporation, and convicted the defendant, fining him 40s. and costs, but the opposing barrister asked the magistrate to state a case as to whether these cases properly come under Section 6 of the Sale of Food and Drugs Act. That case is now under the consideration of the King's Bench Division. (*See footnote to page 13.*)

580. (*Dr. Whitelegge.*) What was the amount of arsenic found in that?—One-eighth of a grain per gallon.

581. (*Chairman.*) And the other 34 summonses have not yet been acted upon?—They are not. They are waiting for that decision.

582. (*Dr. Whitelegge.*) Were they all taken under the same section?—Yes.

583. (*Chairman.*) And when is it likely to come on in the King's Bench?—I believe the decision is expected now. I think within a week or two at the outside the decision should be given.

584. On that decision much may depend in respect to the necessity for fresh legislation?—Yes, decidedly; I should say so.

585. (*Sir William Church.*) If this decision is not upheld by the King's Bench you would have no power of restraining the defendant from going on selling the beer, would you?—Then if you could get a sample containing arsenic you could proceed under Section 3 of the Sale of Food and Drugs Act.

586. (*Chairman.*) Section 3 mentions articles deleterious to the health?—Yes.

587. Section 6 was the other section?—Yes, selling to the prejudice of the purchaser.

588. Beer adulterated with water would come under Section 6?—It would.

589. Were no summonses taken out under Section 3?—I think not, but I have not to do with that part of the business. In fact, I am sure they were not.

590. Can you suggest any reason why Section 3 was not chosen, that being, of course, in your department, a danger to health?—No, I do not know the reasons. That is the department of the Town Clerk, and I do not know what the reasons were.*

591. (*Professor Thorpe.*) You told the Commission that your sanitary authority met and purposely gave warning to these people in order to bring them into the operation of that section?—I do not say that was the reason it was given; it would, of course, have that effect, but I do not say that was the reason.

592. I think that was the answer you gave to Dr. Whitelegge, that it was to bring them within Section 3?—I should like to qualify that by saying that would be the effect of it. Of course I do not know what the object of the Sanitary Committee was in giving that. I do not think the Sanitary Committee in issuing that notice discussed the question of whether the cases would come under any particular section of the Sale of Food and Drugs Act. That was not under discussion at the meeting.†

593. (*Chairman.*) Was arsenious acid introduced into the glucose by the process of conversion?—By the process of converting the starchy matters by the use of contaminated sulphuric acid, and into the invert sugars in the same way.

594. You do not think it possible that the arsenic may have come in the starch, or in some of the other materials

* *Note by Witness.*—Summonses, I am informed, were applied for under Section 3, but on the advice of the Stipendiary Magistrate, were not taken out.

† A chief reason for taking this action was the desire to cause as rapid a withdrawal of arsenical beer as possible.

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used, grain, or sago, or rice?—I do not think that is possible. We did examine one sample of starchy matter, but we have not examined a number of different flours and starches.

595. We know for certain it was introduced by contaminated sulphuric acid in some of the cases; do you consider it was probable that it was introduced in that way in all the cases?—I should take the negative results as very conclusive in regard to a number of these matters; you find a large number of beers which are quite free from arsenic, and in which precisely the same materials otherwise are used as regards starches. For instance crude grain or rolled rice are introduced into the mash tun, but there is no evidence that these materials lead to the presence of arsenic in the beer. The same remark, for instance, would apply to water. The fact that a large number of beers are made from the same water that contains no arsenic shows conclusively that the water of itself could not introduce any material amount of arsenic. A number of materials can be excluded in that manner, and we know that the arsenic was present in the glucose to a very large amount.

Arsenic
malt

596. Has arsenious acid been found in malt?—Yes.

597. Was it found in amounts sufficient to account for any arsenical poisoning?—I think not in any amount sufficient to account for an outbreak such as has recently occurred; but I should not say that the amount found in malt in each case amounted to more than the equivalent of 1-25th of a grain per gallon.

598. Do you think that a slow process of poisoning might not result from such an amount of arsenic?—I think that is quite possible.

599. So that malt is in itself a danger which in some cases may be serious?—Yes, I think so. I think we must regard the presence of arsenic in those amounts in malt as a distinct danger, and as possibly leading to the slow form of arsenical poisoning.

Quantity of
beer consumed by
sufferers

600. Do you think that the comparatively small, but still decided amount of symptoms of neuritis which might be arsenical prior to the recent outbreak, might have been due to malts?—Yes, I do, indeed. I think that is extremely probable, and the high degree of probability which attaches to this will depend partly, I think, upon the amounts of the poisoned beer, which we find that patients consumed who suffered in the recent outbreak. I give on pages 10, 11, 12, and 13 of my report the results of what we ascertained with regard to the amounts of beer stated to have been consumed by persons suffering from well-marked arsenical poisoning, all the cases at the bottom of page 10 having distinct pigmentation with one exception, as follows:—

Amounts of Beer or Stout used daily.	Sex.	Amounts of Beer or Stout used daily.	Sex.
3 or 4 glasses	f	4 or 5 glasses	m
Heavy drinker	f	8 to 10 glasses	m
4 or 5 glasses	f	Large quantities	f
Heavy drinker	f	Large quantities	f
3 or 4 glasses	f	1½ pints	f
2 glasses	f	4½ pints	f
3 or 4 glasses	f	1 pint	f
5 or 6 glasses	m	(Well-marked case, though no pigmentation)	
2 or 3 glasses	m	1½ pints	f
(Probably much more)		(Deep pigmentation)	
4 or 5 glasses	m	2 pints	f
8 or 10 glasses	m	Heavy drinker since August last.	m
4 or 5 pints	m	3 or 4 pints	m
10 to 12 glasses	m	Heavy drinker	m
10 to 12 glasses	m		
12 glasses	m		
5 or 6 pints	m		
8 or 9 glasses	m		

On the following pages I give the entirely spontaneous remarks of a number of practitioners upon that point, and instances which many of them give of small quantities of beer producing definite illness.

601. (Sir William Hart-Dyke.) Had these cases at the bottom of page 10 of your Report been drinking the beer which was proved to have been made from glucoses, or are they cases picked out at haphazard?—These are cases included in the 63 I have given detailed notes of, all of which had been drinking beer made with arsenical glucoses and inverts; so that all these also had been taking the poisoned beers. You will see that in some instances the quantities are surprisingly

small. Of course a certain amount of allowance has to be made in the case of statements made by people as to the amount which they consume, but the aggregate effect of these statements I think is to show that a very small amount, perhaps two or three glasses of beer a day, have produced decidedly poisonous effects.

602. (Chairman.) I see in one case a single pint of small draught beer for supper each night is the amount stated;—Yes, and in a case which may be relied upon as regards the amount of beer, I may mention that a doctor had suffered from slight numbness and tingling in his fingers and some dulling of the sense of touch from the consumption of one glass of beer daily at meals. There is a doubt there as to whether this was arsenical poisoning, but I am inclined to believe that possibly it was, without attaching too much importance to it. I think it is possible it was a case of that nature. He was a very intelligent observer who made this observation, and absolutely to be relied upon, and his impression was that on stopping beer—he ascribed it to the use of the beer he was taking—the symptoms disappeared.

603. (Chairman.) Was this arsenical?—He did not know.

604. (Professor Thorpe.) Was this before the scare?—Yes.

605. (Chairman.) It would take a very large quantity of arsenic per gallon to allow one pint daily to have any injurious effect, would it not?—One-twentieth of a grain per gallon, for instance, a pint is one-eighth of a gallon, and if you take one-eighth it would be one-sixteenth of a grain per day—day after day, month after month; would that be injurious?—Yes, I think so. We know there has been half a grain in some cases. That is quite certain; indeed, in Liverpool, and also in exceptional instances in Manchester, they have found as much as a grain and a-half per gallon, so that one-eighth part of three halves is three-sixteenths of a grain, nearly one-fifth of a grain.

606. Would that be a large medicinal dose?—Yes; and I think quite capable of producing marked symptoms.

607. And taken day after day might be fatal, or very injurious?—It would be very injurious, certainly. One does not like to go too far, but that certainly might be so in susceptible people. Arsenic affects people very differently; the degree of susceptibility to arsenic, that is to say, the power of eliminating arsenic from the system, varies apparently enormously.

608. Are cases known in this country such as those recorded of Styrian peasants who take large quantities of arsenic, getting accustomed to it, and increasing the dose?—I know of no such instance, but I think a great many people drink enormous quantities of beer; brewers' draymen, for instance; and there is no question that a large number of these men have escaped entirely. I presume, therefore, that their systems have in many instances proved capable of coping with the amount of poison they have consumed. The power of eliminating arsenic varies very greatly, a fact well-known before the recent outbreak. The very small quantities which in particular instances have produced symptoms makes it highly probable that in susceptible persons the amount of arsenic capable of being introduced by the malts which have been examined in Manchester would be capable of producing slow arsenical poisoning.

609. So that it is really necessary to look more carefully to the malt than has hitherto been done?—I think no arsenic is permissible in any brewing materials. There is no occasion for it. It is quite any be possible to obtain brewing materials for all practical purposes entirely free from arsenic, and there is no occasion why arsenic should be introduced.

610. (Sir William Hart Dyke.) You mean by proper processes?—Yes, by proper processes and methods.

611. (Chairman.) And would you consider that malt that requires brushing and screening to remove arsenic from it to be safe?—If it could be proved that the brushing and screening were effective in removing all the arsenic, I do not know why one should not. But I should want to have the means of examining the malt and proving it was free from arsenic after the processes were completed.

612. It may be doubtful whether if it has been there at all, brushing and screening could sufficiently purify it?—Yes. I think that malt should reach the brewer without any arsenic with it.

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Individual
susceptibility
to arsenic.

No arsenic
should be
permitted.

613. (*Professor Thorpe.*) How does the arsenic get into the malt?—The arsenic gets on the malt by the process of kilning. On page 45 of my report I show by going over the materials taken from a maltings step by step that you get no arsenic upon the grain before it is placed on the kiln floor.

614. You mean to imply that the arsenic gets on to the malt from the coke or material which dries it?—Yes; it is deposited from the fumes coming off from the fire underneath, whether anthracite or coke.

615. Then the proper treatment would be to take care there was no arsenic in the coke or the anthracite used?—So far as that is possible that is the first requisite. It is, however, difficult to obtain fuel which is absolutely free from arsenic. Still with proper choice of fuel I have no doubt that very little arsenic need be deposited. I think, however, it is essential that what is deposited should be removed. I understand that there are various ways of kilndrying, one being to kilndry without admitting the vapours from the fire to the grain at all.

616. (*Chairman.*) That seems reasonable, and it seems hardly necessary that arsenic should get on the malt?—That would entirely prevent the arsenic on the grain.

617. (*Sir William Church.*) You are not conversant enough with practical malting to say what difficulty there is in drying the malt in drums?—I am not in a position to speak to that subject. I have not seen a kiln of that description. I presume it is largely a matter of expense. I cannot say what the practical disadvantages or disabilities of kiln drying without passing the fumes up through the floor, are.

618. (*Dr. Whitledge.*) You say at page 45 that "It thus appears that part of the grain arrives with arsenic on it, possibly foreign grain kiln dried to make it keep"?—I received a letter afterwards saying that very possibly the cleaning screens had been used for the malt, which is mentioned in the report. I was assured before, that it was not so. There is no doubt that arsenic is deposited on the grain in the process of kiln drying, that I ascertained by getting grain which had been kiln-dried at the maltings, but the arsenic so deposited is removed in the steeping tank, and carried away by the water, so that when the grain proceeds to sprout, and before it is placed on the kiln floor, there is no arsenic on it, or at any rate not sufficient for us to ascertain.

619. (*Chairman.*) Then does hops ever get contaminated in the drying or otherwise?—I give on pages 37, 38, 39 and 40 of the report, the result of the examination of brewing materials, from which it will be seen on page 38, line 3, that a solution from 16 grammes of hops in one instance, and page 39, line 2, a solution from 12 grammes in another instance, yielded a very small amount of arsenic, so that it is manifest that arsenic does in some instances get on the hops. I am not familiar with the process of hop curing, but I understand that sulphurous acid is used in the drying of hops. If an impure sulphur were used, which is possible, a certain amount of arsenic would be deposited on the hops, and as hops are a very light material, of course in proportion to the weight, there would be more than there would be on a heavy material such as malt.

620. Does that coloration by sulphurous acid affect the quality of the hop flavour?—I do not know that it does, and I do not know that it very much affects the quality of the beer, because the amount which can get in in that way is so trifling. I understand that in the qualities of beer which have given rise to these arsenical cases, the amount of hops may average something like 1½ lbs. to a barrel of beer.

621. (*Sir William Church.*) Thirty-six gallons?—Yes, 36 gallons. That is 1½ to 360 lbs., and if the amount of arsenic that could be present in the hops is reckoned up, it would appear that the amount that could be introduced in that way is too small to produce any danger.

622. (*Sir William Hart-Dyke.*) It would be infinitesimal?—Yes. It is not an important matter. Still all the same, I do not say that any brewing should contain arsenic. We do not know in what form arsenic is present in beer; we do not know that it is present as arsenious acid; it is quite possible that it is present as a more poisonous combination, such as arsenic is nothing else than a mechanical action. You

combination, but a compound of arsenic with an ethyl radical—and that being the case I think it will be necessary to insist that no arsenic should be present in brewing materials.

623. (*Professor Thorpe.*) You have no evidence of Form in arsenic in any other form than arsenious acid in which arsenic beer?—There is no direct evidence. I am not a present in chemist, and I have to proceed largely on what I found recorded in treatises on the subject, and I see that it is believed that arsenic in wall-papers produces its poisonous effects in some form, which is more highly poisonous than arsenious acid, and that it assumes this form in presence of fungi which grow on the wall-papers. Now what is possible with wall-papers is possible with beer, the more so that these cheaper beers are very readily overgrown with fungi of various descriptions, and I think, therefore, that there is inherently at all events a possibility that arsenic may exist in these beers in a more poisonous form than arsenious acid.

624. You are reasoning solely from the analogy of the wall-paper?—Not entirely. There have been peculiar features in these arsenical cases. It has been noted by all the physicians that there has been a marked absence in many cases of lachrymation, which is a distinguishing feature of poison by arsenious oxide, and also that there has been in many cases a singular absence of gastric symptoms, of sickness and vomiting, which is also an early feature of cases of arsenical poisoning. That also suggests—I would not like to say more—that the arsenic may be present in some form other than arsenious oxide.

625. I think perhaps we had better dispose of this question. In the question of the poisoning by wall-paper, the presumption is that the poisonous acid is due to arsine or diethyl arsine, and that these arsines are formed by the fungoid growth of which you speak, which are supposed to give off small quantities of hydrogen; and it is this nascent hydrogen, in contact with Scheele's green, where Scheele's green has been used, or the arsenious oxide which has been used as a dressing for the paper, which gives rise to these volatile arseniated compounds. You have in the case of wall-paper, which occasions their presence, a curious garlic odour. That is a condition of things that cannot obtain in the case of beer. There is no similar action in any fermenting process concerned with beer, and therefore there is no possibility of anything in the nature of these arsines being formed?—I scarcely like to enter into that after a distinguished chemist has spoken on the subject. I have not personally any knowledge of beer having a garlic odour or taste.

626. (*Chairman.*) Is a garlic odour ever manifested in the breath in any of these cases?—I have not heard of anything of that kind.

627. I see yeast is mentioned also as a substance in which arsenic is found. You mention it at page 38 of your report?—Yes, it was quite manifest that yeast shows a distinct power of picking up arsenic from a liquor which it is used to ferment.

628. I see in the only two cases mentioned that they both contained a considerable amount of arsenic?—Yes. I give the examination on pages 41 and 42 of a number of yeasts, all of them, it will be seen, containing arsenic, and some of them yield when 50 grammes of the yeast are examined large crystals of arsenic; that is to say, they contain a large amount. The quantity, however, has not been exactly estimated.

629. Is this yeast which has been used in brewing from arsenicated glucose?—These were yeasts to be obtained from current brews from December 29th to January 3rd of this year. They were obtained from the breweries.

630. From breweries where the incriminated sugar had been used?—Some were, and some were not. But all those that contain a large amount of arsenic, with one exception, were from breweries which had used the incriminated sugars.

631. Is there any other source known from which the yeast could acquire arsenic?—Yes, from the malt and hops. In these the amounts are, by comparison, small, but it is manifest that supposing yeast to have the power of picking out arsenic from the liquor to be fermented, if a material is put in which is capable of yielding 1.25th of a grain per gallon the yeast will have arsenic presented to it in sufficient amount to allow it to pick out a fair amount.

632. (*Professor Thorpe.*) Is it not conceivable that the so-called selective action of the yeast in picking out the arsenic ethyl. I do not know the exact chemical com-

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Mr. J. Niven. have, for example, arsenicated malt; the wort, of course, contains a solution of arsenious acid. You add to the liquor the hops, and then the fermentation proceeds. The effect of that of course is that if the hops by any chance contain sulphur, which they very frequently do, there would be a precipitate of arsenic sulphide upon the yeast. Therefore, yeast does not so much take it out by any power of the yeast organism, but it is a simple deposition of the insoluble arsenic sulphide on the yeast material. Is not that a conceivable possibility? Is it not inconceivable that the yeast itself should have this selective action? The yeast plant would not necessarily take away arsenic; it does not select arsenic; arsenic is not food for the yeast. I simply want to put it to you whether it is not conceivable that the arsenic sulphide, which is a highly insoluble substance, is deposited on the yeast?—Could the sulphide of arsenic be formed in that manner?

633. Yes?—Simply from the presence of sulphur?

634. Certainly. Sulphuretted products are formed by the action of the sulphur which is on the hops; if you boil sulphur with arsenious oxide you will get sulphide of arsenic?—Would the mere presence of sulphur suffice to lead to the deposition of sulphide of arsenic from a solution of arsenious oxide?

635. That is my suggestion?—That is a matter which could be very easily determined experimentally. It has not occurred to me to do it.

636. I venture to say that is a more probable reason than the so-called selective action of the yeast. I do not believe in the selective action, but I think I see how the yeast would mechanically act by collecting a precipitate of arsenious sulphide?—I do not know that that occurs, but now it has been suggested it is very easy to put it to the test and settle experimentally whether that deposit does occur. I do not know, as a matter of fact, that such a reaction takes place. I should have thought it would lead to a cloudiness in the liquid which would be noticed by the brewer.

637. But beer is cloudy, is it not, in fermentation?—I mean before the yeast is added. But I think I should prefer to leave the subject of yeast to a gentleman who is more profoundly acquainted with it than I am. My knowledge of yeast is somewhat superficial, but it is a subject which no doubt the Commission will have the opportunity of going very deeply into, and I should prefer not to say very much about it. I have heard suggestions made that arsenic could take a vital part in cell growth; but I really know so little about it that I do not wish to say anything. It is possible that what Professor Thorpe has suggested is the fact, but I do not know that such a reaction occurs, and I should prefer simply to say that it is undoubtedly true that yeast does pick out the arsenic in some way or other from the fermenting liquor.

638. (*Chairman.*) That seems to prove that great care should be exercised in respect to the yeast as one of the ingredients used in brewing?—Yes, unquestionably; in transferring yeast from one brewer to the other, but it is quite evident that if the brewing materials are free from arsenic, viz., sugar, malt, and hops, even if arsenic is present in the yeast to begin with, it will very soon disappear, because the yeast multiplies in each fresh brew, and the arsenic, being a metal, does not multiply, so that that would clear itself. Still, there is a danger, I think, of arsenic being transferred from one brewery to another in the exchange of yeasts which contain a very much larger amount of arsenic than the liquor from which they are made.

639. (*Sir William Hart-Dyke.*) How many years have you been medical officer in Manchester?—About seven years.

640. And your responsibilities extend over a very large population?—Yes, 550,000.

641. And, of course, one of the most responsible charges laid upon you is looking after the possibility of arsenic entering into the food or the drink of the people?—I do not regularly administer the sale of Food and Drugs Act, but naturally the responsibility does devolve upon me of looking after it.

642. There would be an indirect responsibility; that is to say, where you noticed any alarming symptom of an epidemic, or anything peculiar in certain deaths in the district, you would take steps with regard to it at once?—Yes.

643. You would see a full investigation took place?—Yes, if I perceived that. But I think perhaps I might refer you to the table already handed in. (*Appendix*

No. 3.) You will see there was not very much out of the usual occurring. Up to the fortieth week in 1900 there was absolutely nothing, and after that the difference in the number of deaths ascribed to peripheral neuritis was so slight that it might very easily escape one's attention, or be put down to the peculiarities of some practitioner.

644. With regard to glucose, of course, you have been aware for a long period that glucose was extensively used, not only as regards the manufacture of beer, but in the manufacture of jams and other articles of food?—Yes, I have been quite aware of that.

645. It was a matter of common notoriety, and you had special reason to know of its use. Had any suspicion ever passed through your mind before as to the possibility of danger lurking in glucose?—I cannot say there had. I am afraid I have accepted that along with a great many other things. It is quite evident that a great many children take a good deal of glucose as cheap sweets. I was quite familiar with the manufacture of cheap sweets from glucose. I think it is a question which may be reasonably a subject for scientific inquiry how far glucose as an article of food is equivalent to sugar, but I do not think there is anything which would justify one in saying that glucose or invert sugar are not fit articles of food.

646. But you think the question of most imminent importance to be the one as regards beer at this moment?—Distinctly.

647. I apprehend you are also of opinion that the sooner this enquiry now proceeding results in some procedure on the part of the Legislature or otherwise to secure the public the better?—Yes; I think it is desirable that every possible means should be taken to protect the public from another occurrence of a similar nature.

648. And you have no doubt, of course, as to the precise cause of this epidemic at Manchester—you have no doubt whatever as to what it is attributable?—None whatever.

649. You had two processes of examination—that is to say, you examined in a number of cases the glucose and invert sugar in these substances, and also examined the beer itself?—Yes.

650. Did you examine some 45?—Yes. A qualitative examination was made of most of the glucoses. You will see that an analysis is given of the glucose as furnished to me from all the brewers in Manchester on p. 23 of my report, and that all these failed to give any reaction suggesting arsenic except the glucoses and inverts from Messrs. Bostock.

651. Is it much more difficult to ascertain the presence of arsenic in the completed material of beer than in a substance like glucose?—No, I should not say it was. I should say Reinsch's test is particularly good.

652. Is it possible it might exist in the beer and escape detection, whereas it would not escape detection in the glucose?—No, I think not.

653. In part of your report you rather suggest that it is quite possible that disease in some degree may have emanated from the consumption of beer in years past, and escaped the notice of medical men in your district?—Yes.

654. You say, "The suggestion is that there may have been arsenic present in the beer formerly. There is, indeed, reason to suspect that the same phenomena—that is to say, indications of disease—"may have been going on for years, though in a slighter degree"?—Yes, that is so. I gather that in various ways. One of the reasons is that it is a matter of ordinary comment that physicians coming from Scotland find an amount of peripheral neuritis in Manchester which they do not find in Scotland. They find a very small number by comparison in Scotland. One also hears there are very few cases to be seen in the London hospitals by comparison with what is seen in the Manchester hospitals. Then I do not think there is any adequate security that sulphuric acid containing arsenic has not been previously used in the manufacture of glucose and inverts. Doubtless it has not contained arsenic to such an extent as the sulphuric acid in recent use.

655. Do you think it is possible that medical practitioners have not distinguished between disease which has been caused by excess of drinking or consumption of alcohol, whether in beer or otherwise, and that caused by imbibing small quantities of arsenic daily?—They have not distinguished them. I do not think in the

Action of
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Arsonic in
beer before
1900.

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Niven. majority of cases it is possible to distinguish, except by the history of arsenical poisoning.

656. With regard to the process of making beer which you refer to, you compare the different dangers which may ensue, whether from the use of invert sugar, glucose, or malt, from the presence of arsenic in either; are you prepared to state that it would be less danger as regards arsenic getting into beer through the medium of malt, than that in the case of glucose or sugar?—Yes, undoubtedly, but I do not think that it is a danger which can be disregarded.

657. No; I was really asking as a question of comparison. For instance, taking the question of adding sugar as priming to beer when finished, in that case if there was any mischief it would be irremediable? It is applied to the article of consumption when it is approaching completion?—Of course, in that case there is no diminution whatever in the arsenic which is put in. Even allowing for the yeast picking up a certain amount there would not be very much diminution if a large quantity was added in the first instance before fermentation. I think there is some reason for supposing that if you put a very large amount of arsenic into the liquor to be fermented, the yeast fails to exercise its power of picking it out, to a certain extent at any rate. The yeast gets degenerated.

658. And your report tends to show, does it not, that there are two remedies, at all events, in regard to the question of malt, one of which if carefully applied would give something like security to the consumer, that is to say, the process of screening and cleaning the malt, on the one hand, and the process you have alluded to with reference to the abstraction of some of the poison by the yeast?—One cannot consider the abstraction of the poison by yeast at all, because I think that everyone would be agreed there should be no arsenic whatever upon malt before it goes into the mash tun. As to the methods by which the malt is to be freed from arsenic, it is true I have seen an apparatus at four breweries, but I cannot profess to lay down the precise manner in which the malt is to be freed from arsenic. It may be freed by not allowing the fumes to pass up through the malt, and very probably it may also be freed by cleaning processes.

659. Of course, when you refer to the desirability of eliminating all the possibility of arsenic from beer materials, you would agree that in this process, as in many other processes where you have to supply food or drink, great care is requisite; it is a question of care on the part of those who are responsible for carrying out the manufacture?—Yes, I think there ought to be some security that no materials are used which contain arsenic.

660. You examined, I see, a good many portions of this malt dust?—Yes. We took a large number of samples about the 1st January of this year.

661. Have you examined since the outbreak, when special attention was called to this poisoning, any beer which you have ascertained has been brewed purely from malt and hops?—Yes. The beers numbered 38 and 39 are brewed entirely from malt and hops, but these were both from breweries which had formerly used arsenical sugars, and it is impossible to be quite certain that some of it may not have adhered to the vats.

662. From not cleaning the vessels properly, or perhaps from a dirty copper, that had held these other substances?—Yes.

663. You cannot say to the Commission that you have examined any beer which you are satisfied in your own mind had been brewed from malt and hops without any possible contamination such as you suggest?—No, I cannot. I have no doubt whatever that beer brewed in that manner with malt that was not sufficiently clean would contain arsenic.

664. But is not that purely a statement that if there is arsenic in the malt it would be possibly conveyed to the beer unless properly cleaned? You have not tested a sample of beer which you are satisfied had been brewed solely from malt and hops?—Yes, except in so far as some of the arsenic may have adhered from former contamination.

665. With that reservation?—With that reservation.

666. I asked this question of Dr. Tattersall: "You state clearly in your report that if beer had been brewed from malt and hops alone no serious danger from poison with arsenic could have occurred." His reply was: "That is my distinct opinion." I further asked him: "You also say that under no circumstances could beer brewed from malt and hops alone contain more than one-

two hundredth grain per gallon—that is, provided certain things are done"—of course, meaning that the malt was properly cleaned. Have not you referred once or twice to the fact of one-twenty-fifth of a grain of arsenic being discovered in malt?—Yes. Malt and hops are not always properly cleaned.

667. I think you have referred in your evidence once or twice to the fact of one-twenty-fifth of a grain of arsenic being present?—Supposing the malt were turned into beer, and no arsenic had been abstracted on the way, there would be one-twenty-fifth of a grain per gallon in the beer.

668. Providing no steps had been taken in the interim to clean the malt and abstract the arsenic?—Providing that the malt had not been cleaned in the meantime. All malt is not sufficiently cleaned.

669. And this estimate you make was taken from malt, not from malt dust?—Taken from the malt, as it comes from the maltings before it has been touched by the brewers. I may say that I show on page 40 in the case of two samples the results of the operations of the brewer upon malt. On the second operation you will see that although the arsenic was apparently diminished it was not reduced below the limit of something like one-twenty-fifth of a grain per gallon, perhaps actually less.

670. You examined a great quantity of this malt dust, Malt dust, did you not?—Yes; we took a large number of samples of the dust—that is the soft dust. I might explain one form of the apparatus. The grain shoots down into a circular screen, which consists of two or three portions with different sized meshes. In the first part of the screen as it revolves, the malt culms are either broken off or brushed off, and fall through the meshes of the screen. Then the grain passes on to a second part where it receives a little brushing, but it makes really no material difference. Finally, the grain passes through, going to one of the rollers, and passes on until the coarser grains go through the meshes of the third portion of the circular screen, which is revolving, and from these last two portions a quantity of soft dust is thrown off. In a good form of apparatus that dust is carried off by means of fans, or to a less extent by extraction tubes, but if there is no proper apparatus it will fall down and mix with grain going on to the mash tun, and that does occasionally happen. The dust that has been examined is the soft dust which is given off in the subsequent part of the process in the revolving screen, not that passing through with the culms.

671. If this process has the result of taking the poison out of the malt, I presume on examination you would find it in the dust?—There is an indication that a certain amount has been taken out, but in some cases, unfortunately, it is returned.

672. But is it not a fact that you examined a great deal of this dust which was the result of more than one brewing?—Yes, this dust was deposited for a long period. It shows the operations of the brewery for a very considerable time.

673. Supposing the dust you collected and in which you found this poison represents ten maltings, you would have to divide the result by ten to represent the poison for any one malting?—No.

674. I only want to know by what process you got at it?—Perhaps the dust collects over six or seven weeks, and supposing the malt were all the same malt, then there would be simply so much dust collected after each process, which would all contain the same amount of arsenic. Supposing you could collect the dust of one day it would just contain as much arsenic as the dust of 100 days proportional to the total amount. There would be no accumulation of arsenic.

675. I see in your *précis* of evidence you say, "It is not certain however that a slow process of poisoning might not result from the amount of arsenic found to be present in malt"; is that your opinion?—That is my opinion.

676. You conclude this document with several suggestions as to what should be done to secure the public from this poison. You allude in No. 5 to the desirability of amending the Food and Drugs Act so as to insure that in case of any deleterious contamination occurring in beer or stout it may be possible to trace the source of the contamination, and so secure the destruction of the deleterious article. Have you anything to say upon that?—The Sanitary Committee of the City of Manchester were of opinion that further legislation is necessary for the protection of the public, and I thought it well under those circumstances to consult with the Town Clerk.

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Suggested amendment of F. and D. Act.

Mr. J. Nier. The Deputy Town Clerk, Mr. Hudson, who sets in these matters, was of opinion that in that particular the Food and Drugs Act should be amended. We have, of course, no power at present to pass from the retail dealer to the brewery, and that entails not merely a failure in the operations of the Food and Drugs Act, but it prohibits us from being able under the Public Health Acts to seize beer which is grossly contaminated with arsenic, and have it destroyed. Therefore, I am in entire agreement with this recommendation.

677. That is to say, if you seize upon a sample of beer and find it to contain arsenic, you desire power to secure the destruction of the whole of that batch of beer of which it was a part?—There is no means of getting at the batch. It is obvious you cannot go under the Public Health Acts into the brewery and seize beer at random: because it might be entirely different beer from that used by the retailer. The only way in which you could do it would be by having power to follow up the beer taken from the retailer, examine it, and finding that it was similarly contaminated, proceed to its destruction. Otherwise you have no power to proceed to the destruction of the contaminated article.

Class of persons attacked.

678. (*Sir William Church.*) In estimating the number of persons who have been affected, you told us that you sent out a paper of questions to 358 medical practitioners. Does that 358 represent all the registered medical practitioners in Manchester?—Yes.

679. The whole of them?—Yes.

680. I suppose many of them practice chiefly among what one might call the poorer classes of the population, and keep open dispensaries?—I do not think I follow your question.

681. I mean keep dispensaries to which the public can go by paying a very small fee, and obtain advice and medicine?—A man in very good practice indeed may have a dispensary of that kind as a public official. There is a body which deals with the establishment of such dispensaries and governs them, and who have powers of appointing medical officers to them, and these medical officers very often have a good practice outside the dispensary practice.

682. I did not mean officers attached to a public dispensary, but rather those who keep what I might call an open shop, where they dispense both advice and medicine at a low rate?—Of that kind of practitioner there are a few, I should say four or five. I may say of one of those practitioners whom I know, that his judgment may be fairly relied upon.

683. I only ask, because I thought a large number of those who were only slightly affected might in the first instance apply to such dispensaries?—I think that a number of people would go to those practitioners.

684. Did you get answers from practitioners who had that sort of practice?—Yes, from four or five of them.

685. I understood you to say that there were only four or five in Manchester?—No, four or five answers from practitioners doing that kind of practice.

686. But there would be a much larger number doing that sort of practice in Manchester?—Yes; but I do not know the number.

687. Would one be right in considering that the larger number of those who were likely to see the slight cases in the first instance would be some of those who did not communicate with you?—I think so, if it were for nothing else, for the reason that they have a very large number of cases, and have not very much time.

Earliest symptoms observed.

688. You told us some of the distinctions between arsenical poisoning and alcoholic neuritis, and I think I understood you to say that this outbreak of supposed arsenical poisoning was remarkable from the absence of the ordinary symptoms of arsenical poisoning, such as vomiting, diarrhoea, and lachrymation?—In the cases seen in the public institutions, and in his answer to the circular which I sent out, Dr. Brooke was good enough to take some trouble in stating that in the large number of skin cases he saw that was also a noticeable feature that they had not running at the eyes or sickness in the first instance. That a good deal of sickness was caused I feel sure. Many of the practitioners who answered perceived the onset of sickness and running at the eyes.

689. I asked you because the other day it was told us in evidence that a certain number of persons had ceased drinking beer, because it made them so ill?—I was told by a brewer that that was so, that he had heard that a good many people had stopped drinking

because they were taken sick, and I have heard the same thing from other quarters.

690. (*Chairman.*) Was that before the alarm had reached the medical practitioners?—Yes.

691. (*Sir William Church.*) So that the absence of the ordinary symptoms of sickness and diarrhoea, and what we call catarrhal sickness, in the pigmented cases, were rather calculated to put medical men off the suspicion of arsenic?—As far as it goes, undoubtedly.

692. You mentioned the rashes, but you did not tell us at all what sort of rashes they were. There are certain rashes which are more or less known to be associated with arsenical poisoning?—The rashes have been extremely various, and my own experience is somewhat limited in that matter. But the eruptions which I myself have seen have been inflammatory lumps with bullæ on the top, erythematous eruptions, and eruptions more or less resembling psoriasis, while the same person exhibited the different types of eruptions. In one case I have seen distinct pemphigus and herpes zoster has been reported to me by a number of practitioners who answered my circular, and a surgeon at the Infirmary states that he had seen about a dozen cases of herpes zoster amongst his cases.

693. That would be rather secondary to the nerves when it takes the form of herpes zoster?—Herpes zoster I suppose is a nervous eruption, but the erythematous rashes would, I presume, be at a very early stage of the illness, because a number of these were certainly present without peripheral neuritis. I have myself seen a few cases in which there was no peripheral neuritis corresponding to these rashes.

694. Of bullæ?—Yes, or very distinctly erythematous. In fact in one case a man was sent down to me by a practitioner covered with plaques, of a bright red, somewhat scaly looking eruption over the whole of his trunk. That was the kind of case that was absolutely distinctive. One has to take the indications of the dermatologist in this matter as to what the rashes meant.

695. Have you any suggestion to offer why 1898 should have been a year in which alcoholism and its results appears to have been so markedly less than in the years immediately preceding or the years following? You will see the number of deaths in 1898 are only 48, which is much smaller than in the years immediately preceding or following?—I do not know the explanation of that.

Statistics Manchester before 1

696. Is there an increase in peripheral neuritis?—Yes, but not a sufficient increase to cover the decrease of deaths from alcoholism.

697. Looking at the gastritis numbers there is again a very great difference. In 1899 you will see it is only 11, and one would have expected that if arsenic had been playing a part in 1899 and 1900 gastritis would have been figuring higher than it does?—If arsenic in large amounts due to arsenical sugars had been playing a part; but I do not know that one would draw the same conclusions with regard to the amounts which might have been derived from malt for instance. Very possibly these deaths from peripheral neuritis represent a slower and less acute process than the deaths occurring in 1900, so that it might be quite compatible, with an increase in arsenical poisoning, to have a smaller number of deaths from alcoholism and an increased number of deaths from peripheral neuritis. That is assuming that there was a certain amount of arsenic in the sugar also.

698. I think you used the term that you thought the yeast might degenerate. Have you any knowledge from the breweries that the yeast has not developed in the wort?—I was informed by one brewer that his yeast had gone dead; that it had degenerated.

699. (*Chairman.*) It had ceased to be effective as ferment?—Yes; it declined to rise properly, and had been visibly affected.

700. (*Sir William Church.*) And have they had to get fresh wort into the brewery instead of going on with the old?—I presume they did, but I cannot say.

701. (*Professor Thorpe.*) Are we to gather from you that you think the epidemic, if we may so call it, is practically at an end?—I think so.

702. And you know of no fresh cases coming in?—No; not which one could reasonably ascribe to the recent outbreak. Fresh deaths occur.

J. Niven. 703. You mean if there are any cases coming under observation they are to be attributed to the pre-existing conditions?—Yes, or are part of a previous chronic poisoning.

704. I was rather struck in reading your report submitted to your authority with the fact that you yourself had to improvise a laboratory to overtake the work of testing. Would you kindly explain why you are not in a position to call upon the City Analyst to help you in this enquiry?—This is a very special kind of enquiry, and one with regard to which one desires to have personal knowledge.

705. But I understand you had to ask the assistance of a gentleman, Mr. Morton Rowe, to help you?—Yes.

706. You yourself were not able to overtake the work and had to ask the assistance of this gentleman?—Yes.

707. Is not the City Analyst as well as yourself the servant of the Sanitary Authority?—Yes.

708. Why could you not count upon the action of the City Analyst? Was he approached with a view to assisting you in this enquiry?—The City Analyst has, of course, conducted the analysis of beers, which we give in this report. That part of the enquiry he has carried out. I did not approach him with regard to the investigation of other matters.

709. But it strikes me as rather singular that, not only in Manchester, but also in Salford, neither of the sanitary officers was assisted by, or able to count upon the assistance of, the official analyst of the respective corporations. Dr. Tattersall explained to us that he had to go to Professor Delépine at Owens College, and you had to invite assistance from some member I presume of your own staff?—Yes, of the sanitary staff.

710. Therefore, you got no official help apparently in the investigation of this matter from the accredited official chemist; is that so?—That is so.

711. With a view to assisting us in the enquiry which may have to be made in similar cases, may I ask you what that points to? Is there any imperfection in the conditions of tenure of appointment, or what?—No. The Manchester City Analyst did not in the first place find arsenic in the beers which were submitted to him.

712. Was it a matter of public notoriety that even before you were engaged in it arsenic had been found in beers?—No.

713. Was not Dr. Reynolds the earliest discoverer?—Yes; but Dr. Reynolds' discovery had not been announced publicly. The samples which were submitted to the City Analyst were submitted on the 21st November—that is to say, two days before any mention of this occurrence was made in the public Press.

714. Broadly speaking, do you think, from what has taken place during this particular period of stress and strain, that it is desirable that something should be done on the part of local authorities to bring together the two officials, one as analyst and the other responsible for the public health, into more immediate and intimate relation?—That is a very difficult question to answer. I think that in matters requiring special skill, or very exact and careful investigation involving a great consumption of time, it might be an advantage if large towns had some consulting body such as an Institute of Public Health to refer to for assistance.

715. Is the City Analyst at Manchester engaged in private practice as an analyst?—Yes.

716. (Chairman.) A private chemical practice as a chemical consultant?—Yes.

717. (Professor Thorpe.) Is he limited in the amount of analytical work he has to do in return for the salary he is paid?—I think not. I do not remember the exact terms, but it is so much for each sample after a certain amount. The sum diminishes as the number of samples increases.

718. So far as you know, there is nothing in the conditions of his appointment which would have precluded you from asking his assistance in the chemical matters connected with this inquiry?—No.

719. You examined, I think you told us, other glucoses than the one in which you traced arsenic—glucoses other than Bostock glucose?—Yes, a large number—all that we could obtain from the breweries.

720. From the breweries?—Yes, from the breweries of the city.

Mr. J. Niven. 721. Did you examine any other glucoses than those which were found in the breweries?—Yes, I examined as I have mentioned, two glucoses from sweet factories, and one from a jam factory.

722. And in no other sample did you find any appreciable quantity of arsenic than in Bostock's manufacture?—In none.

723. I gather therefore you clearly wish the Commission to believe that the arsenic is solely to be attributed to Bostock's invert and glucose?—Assuming that no other arsenical glucoses were in use besides those which were submitted to us, that would be so. That of course I cannot answer for.

724. You say in your *précis* that the highest amount ascertained in the beer was about half a grain per gallon?—Yes.

725. "But all the samples examined quantitatively were taken after the Sanitary Committee had issued a warning to publicans," on certain dates which you give, "by means of the daily Press"?—Yes.

726. What is the precise significance of the "but" there? You say: "The highest amount ascertained was about half a grain per gallon, but all the samples examined quantitatively were taken after the Sanitary Committee had issued a warning to publicans"?—Perhaps the word is a little loosely used, but I imagine I had in my mind that the amount of arsenic in a great many of these beers is small, and that as these beers were specially selected on account of the illness of patients and on account of the number of cases occurring in special districts, one might have, under other circumstances, expected to find a larger amount of arsenic, especially taking into consideration the great amount which had been found elsewhere.

727. You do not wish to imply that in any case the amount of arsenic originally present had been diluted down by the addition of other beer?—No.

728. You do not think that has occurred?—No, I do not suggest that; in fact, it did not occur to me.

729. You have no reason to believe that it has occurred in actual practice?—I have not thought of it before. It has not occurred to my mind before.

730. I gather that you are clearly of opinion that the whole of the mischief is attributable to arsenic?—Yes.

731. Other suggestions as to what it may be due have no doubt been brought to your knowledge?—The arsenic found is amply sufficient to account for it, to begin with, and I do not know that any proof has been adduced that other matters mentioned could have produced this amount of poisoning.

732. Can you inform the Commission whether the Action by publicans did take advantage of the warning that was issued by the sanitary authority; did they take steps to send back the beer or destroy the beer?—The beer was for the most part rapidly destroyed, although whether that has to be put down to the action of the publicans or to the action of the brewers I cannot say. I presume that the brewers were much more active than the publicans.

733. (Sir William Hart-Dyke.) They instructed the publicans probably. They would strike at the root of it?—Yes, in the great number of instances.

734. If they were frightened at what was going on they would strike at the root of the difficulty and appeal to the publicans to destroy the beer?—There is no doubt the brewers exerted themselves to get rid of the arsenicated beer as far as they could.

735. (Professor Thorpe.) You wish the Commission to understand that the Manchester brewers at all events did all that was in their power to cause the beer incriminated to be withdrawn from consumption?—Without wishing to make myself answerable for individuals, as a body I have no doubt they did do so.

736. Why do you make that qualification?—Simply as a matter of caution; I have no particular brewer or brewery in my mind, but one does not wish to take a general responsibility of that kind without putting in a qualification.

737. Did you attend the inquest which was recently held in Manchester?—I was present for a short time at the inquest, but I did not attend the whole course of it.

738. You said a short time ago that you had been informed by a brewer that the yeast had degenerated in yeast for the presence of an undue quantity of arsenic, that the arsenic degeneration of the yeast was in your view attributable to the quantity of arsenic?—It occurred during the time

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Quantity of
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Affinity of
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Mr. J. Nicen. that this sugar was used and it was quite clear that it was associated in his mind with the use of the sugar, but I have no proof of course that it was due to the arsenic.

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739. But if it were the case, would that disprove the supposition, to put it, as the Chairman stated, that yeast was an arsenic eater?—If the yeast degenerated in the presence of arsenic that would presumably indicate that arsenic was not necessary for the building up of the yeast?—No one would maintain that it is necessary for the building up of the yeast. On the contrary, I should think it would be quite as likely or more likely to break down of a surfeit of arsenic than from any other reason.

740. It was, in fact, over-fed, you mean?—More likely, in fact.

741. The assistant Town Clerk, I suppose, is a lawyer?—Certainly, a distinguished lawyer.

742. And it was in his legal capacity he advised your authority that under the Public Health Act they had no power to follow up this incriminated beer on the brewery?—That is evidently his opinion from this recommendation. I presume also that the advice was given since the beer was not followed up.

743. Do you yourself draw any distinction between beer and any other article of food which under the Public Health Act you could destroy because it was deleterious, say rotten fruit?—I do not; I do not know whether such a discrimination could be made, but I do not make any such discrimination.

744. What are the circumstances in a brewery which would eliminate it from the general operation of the law?—None that I know of. But you have, of course, to examine and inspect. In fact, so far as I can read the Public Health Acts, I do not think they ever contemplated an occurrence of this nature or are applicable to them. The Medical Officer of Health or the Inspector of Nuisances has to examine and inspect, and has to carry off the material to be condemned by a Justice of the Peace, and altogether it is perfectly obvious that the machinery of the Public Health Acts is not, without modification, applicable to such a case as this.

745. (*Sir William Church.*) Is there not a very great difference between this case and that of fruit and meat, where, if you followed that up, you or your substitute would be able to say by an inspection whether it was fit for use or not, whereas you cannot do that in the case of beer?—I think it is manifest that is what the sections in the Public Health Act do contemplate, that it is obvious and easily ascertained faults in the materials to be condemned which allow you to bring them into operation. Moreover, you have to carry the material before the Justice of the Peace to be condemned. You cannot carry off a cask of beer.

746. (*Professor Thorpe.*) A sample would be sufficient. A man who condemns three or four cwt. of fruit does not bring the whole fruit into the police court?—No, the Justice of the Peace might go to the brewery, but I do not think the sections of the Public Health Act contemplate an occurrence of this kind.

747. But supposing it were the fact that that particular lot of beer was set aside in the brewery and the brewer was perfectly willing to indicate that all that beer was arsenicated, what is to prevent you, if you have the necessary power of entry, to order him to destroy that beer?—Nothing. In that case it would come under the operations of the Act.

748. (*Dr. Whitelegge.*) And the brewer would be the principal witness against himself?—Yes.

749. (*Professor Thorpe.*) Have you still in your possession any sample of Bostock's glucose and the acid which they use?—Yes, I think so.

750. Would you be in the position to put that at the disposal of the Commission if you are requested?—I think so. I cannot say how much remains.

751. Perhaps you will kindly take care it is preserved?—Yes, what is remaining shall be preserved.

752. (*Dr. Whitelegge.*) Is there within your knowledge any officer whose official duty it is, under official instructions, to make himself acquainted with and study the dangers to public health arising from the presence of poison in food—is it part of your own official duty?—It is not specified.

753. Not under any public instructions?—No.

754. Is it the duty of the Public Analyst?—No.

755. Is it the duty of any other officer of the local authority as a formulated duty?—Not as a formulated duty.

756. You regard it informally as one of the duties properly falling on you, to watch in a general way?—Yes; I suppose I should do. I may say, however, that I have not administered the Sale of Food and Drugs Act in Manchester.

757. Who does administer it?—The Superintendent of the Sanitary Department.

758. Acting under your advice or instructions?—He would, of course, take my advice in any matter which might occur. I am responsible to that extent.

759. But in ordinary circumstances you take no part in the administration, or direction of the administration of the Sale of Food and Drugs Act in Manchester?—Not in the ordinary current administration.

760. In this particular instance, that of the arsenical poison, did the initiative come from you or the chief inspector?—The initiative came from me naturally, because I was informed of the occurrences of cases of arsenical poisoning; that is to say, I consulted with the Sanitary Superintendent, who at once sent out and procured samples from the tied houses belonging to the breweries which I indicated.

761. You laid down the scheme of sampling?—Yes, in the first instance.

762. Have you received any official instructions as to the methods of sampling, as to the articles that ought to be taken for the purposes of the Food and Drugs Act, from the Local Government Board or from any Government department?—The Local Government Board sent down an instruction, I think, to take samples of jams and sweets and some other matters, which was carried out.

763. (*Chairman.*) In connection with this alarm?—Yes.

764. (*Dr. Whitelegge.*) But apart from that no official intimation has reached you as Medical Officer of Health of the points upon which it is necessary to keep a watch in this connection?—I do not remember any memorandum bearing upon that subject.

765. Do you receive any information as to what is done in other parts of the kingdom?—You are aware, of course, that there is an annual report published?—I am aware of that.

766. Do you receive it?—I do not think so.

767. Not officially?—Not officially.

768. So that you have no official information on the subject?—No.

769. Is there a common understanding as to the number of samples to be taken from the local authority, or the kind of samples?—I think not. I may say that it is understood that a very large number of samples of certain foods should be taken in Manchester—it is well understood a very large number of samples of milk should be taken.

770. An understanding on the part of the City Council?—Yes.

771. But again not arising out of any official statement or instruction?—Not that I am aware of.

772. Is it usual in other towns for the Medical Officer of Health to have charge of this work?—In some towns.

773. In such a town, when the Medical Officer of Health first takes charge, to whom must he look for guidance as to the proper steps to be adopted?—I presume to these annual reports.

774. Which he does not receive?—Which are available.

775. There is nothing in the form of instructions to a newly-appointed officer?—No. Still an officer entrusted with these duties would of course take steps to inform himself as to what was being done in other places as a preliminary to his own work.

776. What staff is available at Manchester for the purposes of these Acts?—There are two inspectors under the Sale of Food and Drugs Acts.

777. For that purpose alone?—Yes.

778. And, as I understand, they are not under your control?—Not immediately under my control. Mr. Rook, the Sanitary Superintendent, put them under my control in the earlier stages of this matter; that was a matter of friendly understanding between us, while after November 28th I was instructed by the Chairman of the Sanitary Committee to take what steps I considered necessary in the matter of analysis.

779. As regards the Public Analyst, his duties, I understand, are to examine samples submitted officially

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P.H. Act
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Powers of
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Vine, to him for the purpose by the public authority or by private persons?—Yes.

1901. 780. It is no part of his official duty under his appointment as public analyst to advise the Corporation?—I should think not.

781. That has never been stated as part of his official duty to your knowledge?—Not that I know of.

782. (Chairman.) Does he make a formal report at stated times?—He is required by Statute to make a detailed report once a quarter, and I have here a copy of such a report.

783. (Dr. Whitelegge.) When samples are sent to the public analyst, are they coupled with instructions what to look for?—Not generally, I imagine. In particular instances, where he might carry out special work more or less of the nature of investigation, he would be naturally told what to look for.

784. In the absence of special instructions, would you expect the analyst to look not only for adulterations and abstractions and substitutions, but also for harmful components?—No, certainly not. I do not think it is possible to expect that the public analyst will make an exhaustive examination of every sample submitted to him.

785. Would you expect a public analyst in the case of samples of beer to look for arsenic?—I should now.

786. Not in past years?—I think not; I think it would be too much to expect that he would be aware of the presence of arsenic in glucose.

787. Then in future years, would you expect the analyst to look for arsenic in beer?—Yes.

788. In all samples of beer?—Yes.

789. And to determine it quantitatively?—If present, and if possible.

790. You would extend that I suppose to other food substances in which harmful ingredients had been found from time to time?—Poisonous ingredients, yes; after a due warning of those ingredients and materials had been conveyed to the public analyst.

791. By whom?—By the sanitary authority.

792. But in the case of beer, do you think a special warning to the sanitary authority is needful?—Not now.

793. Is any warning within your knowledge given to a public analyst by anybody else but the public authority, or as a matter of public notoriety?—No.

794. He does not receive instructions from the Local Government Board or Government laboratory within your knowledge?—No, not formal instructions.

795. Have you acted in consultation with the analyst as to the samples to be taken?—No.

796. I want to make clear about your powers, as you understand them now under the Sale of Food and Drugs Act and the Public Health Act; and first as regards the retailer. If we assume that the retailer of beer and the brewer and the manufacturer, let us say of sulphuric acid, all have their works within the Manchester district; you have power to take samples from the retailer, to have those samples analysed, and to take proceedings against the retailer, because of adulteration. If he has a warranty from the manufacturer who supplies him—that is the brewer—have you power to take proceedings against the brewer?—I am not certain, I should have to look up the Sale of Food and Drugs Acts.

797. You have no experience at all events in connection with taking procedure under warranty?—I do not remember the sections relating to the warranty, but the working of the warranty sections have been so complicated and unsatisfactory that I would not like to commit myself on any point connected with that without looking them carefully up.

798. Then we will go on to the brewers. As a matter of fact the brewers gave you assistance and information, I understand?—Yes, that is manifest, because one could not have carried out these examinations without such assistance.

799. Assuming that the brewer had not been willing to give the information you required, do you consider that you have power of entry in brewers' premises in any circumstances?—To take samples?

800. For any purpose?—To see if there was a nuisance.

801. Would you have power of entry for the purpose of taking samples?—I understand not.

802. (Chairman.) You could not demand samples of the different products?—No; that is the view taken in Manchester that we could not demand samples from the brewer. Mr. J. Niven.
1 Mar. 1901.

803. (Dr. Whitelegge.) You cannot tell us the reason why you cannot demand samples?—No, I cannot.

804. Assuming you had no difficulty in obtaining entry and that you succeeded in obtaining samples, then unless in the case Dr. Thorpe mentioned when the brewers themselves volunteered the information that it contained the arsenic, you would not know by inspection that it contained arsenic until after you had removed the sample, sent it to the analyst, and received the analyst's report?—That is so.

805. Then upon that report if you could establish the identity of the sample with some beer still left on the premises you could seize that beer, you think—not under the Sale of Food and Drugs Act, but under the Public Health Act?—Yes, if you can establish the identity.

806. Do you anticipate difficulty in establishing identity?—Yes. You would have to sample every barrel in the place; it would not do merely to examine one sample of beer; you would have to examine the whole series.

807. Having proceeded to seize this sample you would have to call in the Justice of the Peace to get it condemned?—That would be so.

808. You know of no case of the kind?—May I say, further, that the Justice of the Peace would have himself to come to a conclusion as to whether the beer was unfit for food, and his conclusions might not agree.

809. His conclusions might be legitimately based on the evidence you placed before him?—Yes. He would have the same evidence.

810. To go a stage further, would you consider your position the same in the case of a chemical manufacturer who supplied the brewer who supplied the retailer. If you found a chemical manufacturer making sulphuric acid which contained arsenic, would you have any power at all with regard to him?—I think not.

811. Would you under any circumstances have power to seize the sulphuric acid containing arsenic?—I think not. You would have to establish that it was going to be used for food, and I think the difficulties in doing so would be insurmountable.

812. I did not quite follow one of your answers to Dr. Thorpe's questions, but I want to ask you for my own information. Do you consider that there is probably any arsenical beer remaining in Manchester at the present time, whether waiting for rebate duty, or for any other purpose; or, on the other hand, has it been all destroyed?—I should like to be quite clear about that question. By arsenical beer, do you mean seriously contaminated beer?

813. Yes, I do?—I should be inclined to think that there was none, but it would be difficult to be certain of that.

814. You think there is now no beer brewed from the incriminated sugar refinings?—I do not think so; but of course one cannot be sure of that.

815. On page 42 of this report, dealing with malt, you mention one particular brewery. "In No. 15, the quantity of arsenic was conspicuously large, a brewery which had not used Bostock's sugar." Can you tell us anything about the beer from that brewery?—No, I cannot. Arsenic in malt dust.

816. You cannot identify it with any of the figures you have given us elsewhere?—No. That is not amongst any of the beers which have contained arsenic, and I cannot be certain whether a sample has been obtained from No. 15. I am quite sure it is not one of the beers that have contained arsenic, and I am not sure that samples have been taken.

817. (Chairman.) In No. 15 I see you say that the quantity of arsenic was conspicuously large, a brewery which had not used Bostock's sugar?—Yes; but on the other hand, there was no great quantity of arsenic, no excessive quantity of arsenic in the yeast. Now, it is manifest that that means there was no great amount of arsenic in the beer.

818. What do you mean by the quantity being conspicuously large?—That was in the malt dust.

819. Not in the beer?—No; that simply shows that very arsenical malts had been used, but it gives no indication as to how much arsenic may have been taken out of these malts by the screening and other prepara-

Mr. J. Niven. tions at the brewery. That you must infer from the state of the yeast. The yeast at the same brewery simply gives crystals—that is to say, contains no large amount, and one may reasonably infer that the amount present in the beer would have been such that it would not have been detected by our tests.

820. Does not "exceedingly fine large crystals" means a large quantity of arsenic?—It means there has been a large amount originally in the malt which may have been taken out in the screening operations.

821. Was the beer of that brewery examined?—The beer was not examined, but the yeast was examined. The yeast is given on the same line, No. 15, three from the bottom in the series.

822. But when so large a quantity of arsenic was found in the dust, was it not considered desirable to test the beer?—The beer was not tested, but it is manifest from the condition of the yeast that the beer would not contain a large amount of arsenic; indeed, it would contain a very small amount.

823. The smallness of the quantity of arsenic in the yeast was considered sufficient to guarantee the safety of the beer?—I do not consider any beer quite safe that contains arsenic at all, but it is quite sufficient to guarantee that the amount in the beer would be very small.

824. (*Dr. Whitelegge.*) Is it within your knowledge that there has been an increased use of Bostock sugar in breweries in Manchester since about 1896?—I have no facts bearing upon that.

825. *Dr. Tattersall* gave us evidence on that?—*Dr. Tattersall* made that investigation.

Future action
available to
M.O.H.

826. As the outcome of recent experience, what future routine do you propose to adopt in Manchester in the matter of safeguarding the public health against the risk of arsenical poisoning in beer? To begin with, what steps would you take to ascertain future cases of peripheral neuritis or other mischief that could be attributed to arsenic?—I think it is necessary to take a considerable number of samples of beer for chemical examination, and to examine them for the presence of arsenic, and to prosecute should the beer be found to contain arsenic.

827. You would rely in the first instance on the Sale of Food and Drugs Act, and take samples and examine them specially for arsenic?—Yes, I should.

828. Are you taking steps to inform yourself of any future cases of arsenical poisoning; have you adopted any procedure?—No formal procedure.

829. Do you propose to adopt any?—I do not know that any formal procedure is practicable except to visit the public institutions and get the resident physicians to show one any cases which they may have. You cannot expect private practitioners to inform you of these matters.

Obtaining
returns from
Hospitals.

830. But you would obtain returns from the public institutions?—It is perhaps desirable to obtain returns, but I think it is desirable to see cases personally.

831. That is rather more onerous, is it not?—Yes.

832. At any rate, you propose to keep in touch with the public institutions with special reference to this particular point?—Yes. And I think the suggestion you offer as to obtaining returns is one I should be inclined to follow out.

833. And that would be equally necessary in other towns as well as Manchester?—Yes, no doubt.

834. (*Professor Thorpe.*) Are these public institutions in any way under the control of the municipal authority?—No.

835. Absolutely disassociated from it?—Yes.

836. Have they not even a visiting power?—No; still they are expected to give information on matters of this kind to the public health officer, especially if requested.

837. (*Dr. Whitelegge.*) Practically you are in touch with the Royal Infirmary and the other public institutions?—Yes.

838. And obtain information from them?—Yes.

839. Do the figures you have given us include the cases at the Skin Hospital and other special hospitals?—They do. It is, of course, always better to have these matters put on the formal basis.

840. To have an automatic machinery for the purpose?—Yes.

841. (*Sir William Church.*) As medical officer of health, are not the returns of the cases in the Poor Law

Infirmary at Crumpsall, for instance, submitted to you? *Mr. J. Niven.*—The numbers.

842. Only the numbers, not the diseases?—No, only the numbers. I heard not a word of this occurrence until *Dr. Reynolds* informed me on the 20th November, not a whisper of anything of the kind being in progress.

843. (*Dr. Whitelegge.*) Have you any reason to think that the mortality returns are understated; is there any tendency, for example, to make out the death certificate for some symptom rather than the cause in this case?—Doubtless in a number of the cases other phenomena of the disease would be put down in the death register, such as heart disease, bronchitis, and that kind of thing.

844. Addison's disease, possibly?—Yes, in cases of pigmentation, possibly Addison's disease.

845. But you have no knowledge of that having been done?—I have none. I have not searched the register for that. I should think it was much more likely they would be put down as heart disease or bronchitis.

846. Do you attach any importance to influenza as bearing on the recent prevalence of cases of arsenical poisoning?—No.

847. Nor to other zymotic influences?—No.

848. *Dr. Reynolds* gave us particulars of some cases, and I think you referred to them in your report, of tending to establish the time of development of the disease?—The period during which it was necessary that the poison should act.

849. The minimum interval?—I have obtained only two cases in which it was possible definitely to obtain the interval. It is page 13 of my report:—"Case A.—A woman was discharged from Crumpsall Workhouse five weeks ago (Report, Dec. 7th, 1900). At that time she was not suffering from alcoholism or arsenical poisoning. After her discharge she took beer very freely for a week or so, after which she had only two or three gills per day. She first noticed something wrong a fortnight after discharge, the first symptoms being numbness of the feet, followed by tingling. About this time she had vomiting and diarrhoea. She has now well-marked pigmentation. (Brewery from which beer obtained C, also B.) Here the poisonous effect was produced at most in a fortnight, and probably more nearly in a week. Case B.—A man, age 42, was treated for rheumatism in Ancoats Hospital for three months. He was discharged from Ancoats Hospital six weeks ago (Report dated Dec. 8th, 1900), and two weeks after discharge his eyes began to water very freely, and his feet and hands began to burn. (Admitted into Chorlton Union Hospital on November 24th, 1900.) Present condition—symptoms of peripheral neuritis well marked. Excessive sweating of the hands and feet, which are erythematous and scaly. This man drank four or five pints of beer daily from one source. (Brewery C, also B.) Precisely the same remarks apply here as in the previous case."

Shortest
of deve-
ment of
symptoms
of poison

850. Can you tell me about Case A; how long she had been in Crumpsall?—I cannot.

851. You are satisfied that as a minimum a fortnight is sufficient?—These cases appeared to show that.

852. Are you prepared to accept anything as a negligible minimum of arsenic in beer as the result of your experience?—No.

853. Would you go so far as to say that there must not be even a trace of arsenic?—Yes, I should.

854. Then you would not agree with the recommendation, which probably was a provisional recommendation, made by the expert Committee?—No. I think if you allow a certain amount determinable by chemical tests you are always in danger of getting more.

855. And therefore you would insist upon the entire absence of arsenic?—Yes.

856. (*Professor Thorpe.*) Entire absence of arsenic can only be determined by a chemical test?—That is so, and you must take some simple and well-known chemical test which will show the presence of a very small amount, and yet fail to detect an infinitesimal amount.

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should
be allowed
beer.

857. That itself indicates a minimum?—No doubt.

858. It all depends on the character of the test you apply as to where you draw the line?—Yes, by the finest available test.

859. Your recommendation comes to the definition of a test?—That is so; ultimately you cannot avoid that.

860. (*Dr. Whitelegge.*) But if I understand you rightly you would fix upon the most delicate test, and insist there

Niven. should not be enough arsenic to give a positive result with that?—That is my opinion.

r. 1901. 861. Would you consider arsenic, in any quantity whatever, in beer a deleterious substance?—I cannot say. I should regard it as a contamination.

862. But you would not go so far as to say that it was necessarily a deleterious contamination?—No one could scientifically do so.

863. There are certain recommendations at the end of your report. I want to ask you with regard to the last of those. You say, "It is desirable that the Food and Drugs Acts should be amended so as to ensure that, in case of any deleterious contamination occurring in beer or stout, it may be possible to trace the source of the contamination, and so to ensure the destruction of the deleterious article." Could you tell us what sort of machinery you think of for giving effect to that?—No, I am not prepared to.

864. You have not thought out the details?—No. That is the joint recommendation of Mr. Hudson and myself carrying out the wishes of the Sanitary Committee in regard to legislation.

865. The earlier recommendations on the list amount practically to a stipulation that the manufacturer of food and drink shall always, in ordering his chemicals, say they are for the manufacture of food and drink, and that the chemical manufacturer shall supply them to him avowedly for that purpose?—Yes, with a statement securely attached to each consignment of that fact as well as on the invoice.

866. I think it came out in evidence that the invoice used by Messrs. Bostock had some such heading?—No, I think not. I think they call themselves sugar refiners.

867. Would not that imply making food substance? It did not succeed in conveying that impression, but would it not bear such an interpretation?—My suggestion is that it should be clearly stated on the order that the chemical was to be used in the manufacture of food, using the word "food" or using the word "drink."

868. You would have it written, and not merely printed as part of the heading?—Whatever would be most likely to be most effective.

869. Do you anticipate any difficulty in defining "chemicals"?—I did not put this forward as legally perfect or as technically perfect. I think, perhaps, it might be an advantage if the chemicals which were most in use in the manufacture of food stuffs were specifically mentioned.

870. (*Professor Thorpe.*) Would baking powder be a food or a chemical?—Baking powder is clearly a chemical, so is acetic acid used in pickling. I may say I have examined six samples of pickling vinegars but found no arsenic in them.

871. Take pickling vinegar, you consider that as a chemical?—I do.

872. Would you require this procedure in the case of a private purchaser, or only in the case of a purchaser who was going to submit the articles to manufacture on a commercial scale?—I was only contemplating persons intending to manufacture it on a commercial scale.

873. But the same sort of danger would apply to the

private purchaser?—Yes, but you may make impracticable laws.

874. Would not there be a difficulty again; take the case of sulphuric acid supplied to Messrs. Bostock; the vessels would have to be labelled as you suggest, and they would be returned with the labels on, would not they, and would not there be a danger of the labelling becoming a mere form?—Yes, and the vessels being filled up without fresh labels.

875. Did not something of that kind come out in evidence in the inquest?—It came out in evidence that the red mark was retained on the consignment although the sulphuric acid was not pure; a mark which was intended to signify purity was still retained.

876. (*Chairman.*) And impure acid put in it?—Yes.

877. Would not that be a very serious matter?—In my opinion it is a serious thing yes. In that case possibly it might be necessary to destroy the label, to put in a qualification that the label should be destroyed after each consignment had been used.

878. (*Dr. Whitelegge.*) There would be some difficulty, would there not, in enforcing a system of that kind by inspection?—Yes. I think it is clearly necessary that these special chemical manufactures should be visited under the Home Office, and should be submitted to distinct regulations.

879. (*Professor Thorpe.*) Why the Home Office as against the Local Government Board?—Because the Home Office usually deals with matters of that description as I understand, not for any other reason.

880. (*Dr. Whitelegge.*) By matters of that kind you mean matters relating to manufacture?—Yes.

881. But not matters connected with public health?—No, that falls to the Local Government Board.

882. (*Sir William Hart-Dyke.*) Will you kindly inform the Commission what amount of arsenic, medicinally speaking, it is considered safe to give a patient?—Medicinal dose of arsenic 16 drops of liquor arsenicalis is often given to children, and sometimes produces poisonous symptoms.

883. What would that be equivalent to in grains?—Three-tenths of a grain per diem, I think.

884. (*Sir William Church.*) It is a very large dose. That is the amount that you give in twenty-four hours?—Yes. This is a paper by a practitioner in Manchester which you may have seen, who used it very largely in the treatment of St. Vitus's dance, and a certain number of the cases were affected with symptoms of peripheral neuritis.

885. (*Sir William Hart-Dyke.*) It is taken in cases of neuralgia as a pain-killer, is it not?—I do not know. I have not had much experience of it.

886. I asked you because I have taken it myself largely?—The usual medicinal dose is from 2 to 8 drops, that is to say one-fiftieth to one-twelfth of a grain.

887. (*Chairman.*) Drops of Fowler's solution?—Yes, which would be about one-fiftieth to one-twelfth of a grain.

888. I have been prescribed one drop with each meal, that is four times a day. That would be a small dose?—Yes, that is a small dose. Some people suffer from small doses. They get sick with very small doses of Fowler's solution.

Mr. J. Niven.

1 Mar. 1901

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Medicinal
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THIRD DAY.

AT WESTMINSTER PALACE HOTEL.

Wednesday, 6th March, 1901.

PRESENT:

The Right Hon. LORD KELVIN (in the Chair).

The Right Hon. Sir WILLIAM HART-DYKE.
Sir WILLIAM CHURCH.
Mr. COSMO BONSOE.

Professor THORPE.
Dr. WHITELEGGE.

Dr. BUCHANAN *Secretary*.

Dr. EDWARD WILLIAM HOPE, called; and Examined.

Dr.
E. W. Hope.

6 Mar. 1901.

Epidemic in
Liverpool,
extent.

889. (*Chairman.*) You are Professor of Public Health at the Victoria University and Medical Officer of Health for the City and Port of Liverpool?—Yes.

890. Have you investigated or have you means of knowing the amount of sickness and death in Liverpool due to the recent epidemic?—Yes, I have. I was one of the members of a small sub-committee appointed by the Liverpool Medical Institution to investigate the extent of the poisoning epidemic in Liverpool, and that sub-committee tabulated 100 cases of poisoning which admitted of very easy verification. They were all of them cases which had been treated in public institutions, and consequently were open to the observation of any medical man who was interested. But besides these, a very large number of cases came under notice of illness attributed to arsenic, but in these cases they did not admit of the same verification, and I have not therefore tabulated them. I may say that out of the total number eight of the cases proved fatal, and in four of these inquests were held. Perhaps I may as well say here that arsenic was found in the viscera of some of these, and there was no doubt whatever as to the cause of death.

891. Was there any evidence as to how the arsenic had got into their systems?—The evidence showed conclusively that beer was the medium by which the arsenic was conveyed.

Inquiries by
M.O.H.

892. Has any attempt been made by you to find out the number of such cases in private practice? You spoke, I think, of other cases besides these 100?—Yes. I made inquiries of medical men; in fact, medical men volunteered information, and the actual number of people poisoned I believe to be largely in excess of 100. At the same time, in many of these cases there were perhaps elements of doubt, and I thought it best for the purposes of this inquiry to confine myself to those cases about which there could be no possible doubt.

893. Those 100 cases were all treated by public institutions?—Yes.

894. What were those institutions?—Chiefly the Mill Road Infirmary, and a few at the Brownlow Hill Workhouse. Both institutions are in Liverpool.

895. Were both those institutions for very poor classes of people, and for the artisan class?—They are Poor Law institutions.

896. So that the inmates of those hospitals were persons receiving Poor Law relief?—They were persons who in time of sickness would naturally apply to those institutions. It does not follow that prior to their sickness they were in receipt of Poor Law relief, but when sickness came that was the most ready way of getting relief.

897. Persons of the artisan class, labourers, and workmen, would apply to such hospitals?—Yes.

898. For themselves or their wives and children?—Yes.

899. (*Dr. Whitelegge.*) Have you any figures showing the sex of these 100 cases?—I have not them with me except the fatal cases.

900. What are the approximate dates of the commencement and the end of the outbreak in Liverpool, as far as you can judge?—The probable commencement appears to have been about June or July, and the removal of the cause of the poisoning was about the 27th or 28th of November, perhaps subsequent days. Cases of poisoning have occurred since that date, but the actual poisoning happened prior to it, although people sought relief afterwards.

901. Are new cases still coming in?—I do not think there have been any new ones in the last fortnight or so, but all new cases coming to the hospital have been poisoned prior to the 27th or 28th of November.

902. Do you think the danger is over for the present?—Yes.

903. (*Professor Thorpe.*) You say you are clear in your mind that the exceptional sickness and death are due to arsenic no other cause than arsenic?—That to arsenic in beer.

904. (*Chairman.*) In respect to arsenic in beer, have you any reason to think that there has been arsenic in beer previously, and that detrimental effects have resulted from it previous to this outbreak?—Yes, it would appear so, although there are no analytical reports to support that belief. It is by inference that I base the opinion that there was arsenic in beer some months prior to the 26th of November, when it was definitely ascertained to be there.

905. In previous years?—No, last year I mean.

906. In previous years have you reason to think that there might have been something of the same deleterious influence, if not to the same extent?—It is possible, but I have no evidence to show that that was the case.

907. The forms of illness, peripheral neuritis and alcoholic neuritis, were shown before this outbreak?—Yes, we are very familiar with alcoholic neuritis in Liverpool.

908. And do you think that in some cases previously to the year 1900 the illness may have been really due to arsenic, and not merely to alcohol?—Yes, it is quite possible that it may have been, but we have no evidence to show that that is the case.

909. Do you know anything of beer having been suspected and tested for arsenic before the recent outbreak?—I know it is our routine practice as a health authority to cause analyses of beer as well as every other article of food to be made, but we have never had any report from the analysts to show that there was arsenic in beer until November of last year.

910. Was the analysis previous to last year of such a character that arsenic would be detected by it?—That I am not in a position to say. All that I can say is that the samples were certified to be genuine samples, and I cannot think a sample would be certified to be genuine if it contained a deadly poison such as arsenic.

911. But if the analysis was not directed to the test of that poison it might have been there and not discovered?—If the analysis were not directed to that poison, of course, it might have been; but the analyst will, of course, give you his own information.

Dr.
E. W. Hope.

6 Mar.

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Dr. 912. Do you know whether illness has arisen from the use of chocolate or syrups or jams or marmalade or preserved sweets?—No, there is no reason whatever to suppose that arsenic was in any kind of jam or sweets or confectionery at any time.

913. Or preserved fruit, or syrup and golden syrup?—Or preserved fruit. No, nor in fruit wines. As a matter of fact, a large number of these samples were specifically tested for arsenic in November, December, and January, and none of them contained any trace of arsenic.

914. I believe those confections and syrups contained glucose largely?—Yes.

915. The syrup, I suppose, was almost entirely glucose?—No, golden syrup is not glucose. It is cane sugar—pure sugar.

916. Did treacle or substitutes for treacle contain arsenic?—They might contain it, but there was no arsenic found in any of the large number of samples examined.

917. Treacle was examined, I suppose?—Yes.

918. And the treacle, of course, came originally from cane-sugar as a by-product or refuse, but more recently it has been, I believe, manufactured from glucose?—Yes, I believe so.

919. But in no case has arsenic been discovered in any of these substitutes, has it?—No, none whatever.

920. It has been a routine practice, you told us, to take samples of all kinds under the Food and Drugs Act?—Yes.

921. Was bread tested?—Yes, large numbers of samples of bread, flour, and other things.

922. And if there was some arsenic in the yeast used in the bread that would show in the bread?—If there had been arsenic in the bread it would have been detected.

923. It would have been detected by the tests that were made?—Yes. The analysts have, I know, made specific tests for arsenic in almost every kind of food stuff.

924. Before the present inquiry?—No, coincidentally with it; at the same time that the arsenic was found in the beer.

925. Not very many samples of beer were taken for analysis before the recent occurrences?—No, very few, analysed by Beer has been so uniformly reported to be genuine that the numbers of samples taken of it were allowed to fall down to a very small number.

926. The test for genuineness of beer at that time would not have shown arsenic?—I presume not.

927. (Sir William Church.) Could you inform us at all whether the number of cases of peripheral neuritis or neuritis of all kinds, in Liverpool was greater than the average found in other large towns, or is it the same?—I could not say. I have no comparative figures, but I have a table showing the deaths for the last two years from those causes and from alcoholism.

928. You do not know how that compares with London or Newcastle or other large towns?—No, I do not.

The Witness handed in the following table:—

CITY OF LIVERPOOL.

1900.

Deaths from	1st Quarter.		2nd Quarter.		3rd Quarter.		4th Quarter.		Year.		Total.
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
Excessive Drinking	17	12	14	11	12	17	11	12	54	52	106
Natural Causes accelerated by excessive drinking.	15	7	22	12	15	17	19	13	71	49	120
Alcoholism	1	—	6	4	4	2	3	1	14	7	21
Neuritis	—	—	—	—	—	—	—	—	—	—	—
Peripheral Neuritis	—	—	—	2	—	1	—	4	—	7	7
Multiple Neuritis	1	1	—	—	—	—	—	1	1	2	3
Alcoholism accelerated by some irritant poisoning.	—	—	—	—	—	—	—	1	—	1	1
Alcoholic Neuritis	—	*(1)	—	(1)	—	†(1)	—	†(1)	—	(4)	(4)
	34	20	42	29	31	37	33	32	140	118	258

Those figures marked () were included under Excessive Drinking or Alcoholism.

* Inquest.

† Mill Road Infirmary.

1899.

Deaths from	1st Quarter.		2nd Quarter.		3rd Quarter.		4th Quarter.		Year.		Total.
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
Excessive Drinking	11	8	14	8	12	6	13	8	50	30	80
Natural Causes accelerated by excessive drinking.	21	13	18	6	20	8	20	12	79	39	118
Alcoholism	4	3	1	4	6	4	2	3	13	14	27
Neuritis	—	—	—	—	—	—	1	—	1	—	1
Peripheral Neuritis	1	2	—	2	1	3	—	4	2	11	13
Multiple Neuritis	1	—	—	—	1	—	—	—	2	—	2
Alcoholic Neuritis	—	*(2)	—	*(1)	—	—	—	*(1)	—	(4)	(4)
	38	26	33	20	40	21	36	27	147	94	241

Those figures marked () were included under excessive drinking or alcoholism.

* 2 Mill Road Infirmary
2 Brownlow Hill Workhouse } Not Inquests.

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929. (Chairman.) Do you know whether peripheral neuritis was reported either, for example, in Newcastle or in London?—No, I believe it was, but I have not gone at all into the question.

930. Can you give us some information with regard to the Mill Road Infirmary and the consumption of beer in Liverpool?—At the Mill Road Infirmary there was an increase in the number of cases of what we believed to be alcoholic neuritis in or about September, and the medical superintendent of the institution drew my attention to that circumstance. It was chiefly amongst women, and it happened at a time when there was evidence to show that money distributed to Reservists' families and others was not being well applied, and we attributed the increase of alcoholic neuritis to an increase in the drinking habits of certain sections of the community, who obtained money from charitable people. There is evidence to show that there was an increase about September or October, and that attention was directed to it; but it was not until November 25th that there was actual evidence as to arsenical poisoning. At that time the sanitary authority of Liverpool felt that the position was one of exceptional gravity on account of the very large quantity of beer consumed in Liverpool and of the large number of houses at which the beer is sold. I believe that the amount of beer consumed in Liverpool approximates to three-quarters of a million gallons per week.

931. What is the population of Liverpool?—668,000.

932. Roughly, three quarters of a million?—Yes.

933. So that that would be about a gallon a week per head, man, woman, and child?—Yes, approximately.

934. That seems an enormous consumption?—It is an enormous consumption. There are 2,223 houses within the city where beer is sold. It was obvious to the sanitary committee and its advisers that if beer was to be the medium, or might be the medium, of arsenical poisoning, that very prompt measures were necessary to deal with what might prove to be a catastrophe. If beer were poisoned, the results would be almost as lamentable as if water were poisoned. The circumstances needed the promptest possible measures to deal with them.

Analysis of
Beer for
arsenic before
1900.

935. (Dr. Whitelegge.) I want to be quite clear about the conclusion you draw from the analysts' certificates dated prior to the suspicion of arsenic. The samples in October and before October were reported as genuine, were they not?—Yes.

936. You drew the conclusion from that that there was nothing harmful in them?—Certainly.

937. If the question of arsenic had arisen would you have concluded from those certificates that there was no trace of arsenic?—I should have concluded that there was no trace of arsenic, or that the attention of the analyst had not been given to the possibility of such a thing, and that he might perhaps not have examined it for arsenic.

938. Do you rely upon the analyst to examine for what is necessary?—Absolutely.

939. You give him no instructions on sending him samples?—No. I need hardly say that in the face of this emergency circumstances were very altered, and he needed no instructions to examine for arsenic.

940. (Chairman.) It was not usual formerly to test for arsenic at all, was it?—I cannot say whether these samples were tested for arsenic or not. I do not know. I have not asked the analyst. As a matter of fact, I do not think they were; but I have not asked him.

Glucose an
adulterant of
golden syrup.

941. (Dr. Whitelegge.) You told us that glucose was found in treacle and other articles that were examined?—Probably.

942. What action do you take in such a case?—We would deal with an article which was sold as a cane sugar and which contained glucose as an adulteration under the Food and Drugs Act.

943. And if it was sold as treacle?—That is another matter.

944. Then no line of action has been defined?—It has not been defined, but golden syrup is understood to be a product of pure sugar.

945. (Chairman.) Cane sugar?—Cane sugar or beet sugar.

946. (Professor Thorpe.) With reference to that answer, you are quite familiar with the fact that golden syrup, although presumably derived from cane sugar or beet sugar is occasionally mixed with glucose?—No, I am not aware of that except illegally. It may be so illegally.

947. You in Liverpool probably have as many prosecutions for the admixture of glucose in so-called golden syrup as anywhere?—I dare say. At the same time, we have only had a very few.

948. I think I may say, as a referee under the Food and Drugs Act, that it is notorious that you in Liverpool have taken an active part in putting down the illicit admixture of glucose with cane sugar molasses, and selling that as golden syrup?—Yes, most likely. I daresay we are more active than most other places.

949. Yet you tell the Commission that even in such samples of golden syrup as have been examined, and which at least presumably might contain glucose, there has been no evidence of arsenic found?—No evidence at all, although they have been specifically examined for arsenic.

950. Are you in a position to tell the Commission what would be the origin of the glucose which would be in golden syrup? Would it be a native, or imported glucose?—I could not give you that information.

951. (Sir William Church.) I should like to know how the figures of the consumption of beer are arrived at in Liverpool?—It is a calculation which I made myself upon evidence given before the Licensing Bench as to the amount sold at individual houses, and I believe it to be well within the limit.

Consumption
of beer
in Liverpool

952. You got the returns from the different licensed houses of their weekly sales?—No, that is not quite so. The evidence was given in the case of a number, and upon that, taking those as a fair criterion and as a fair average, I made my calculation of the rest, and that calculation has not been questioned by those who might question it if it were inaccurate. It is merely an estimate.

953. It has not been checked in any way by the deliveries from the breweries, which I suppose could be ascertained?—Yes, I daresay it could be checked.

954. It seems such an enormous amount?—It does; it seems almost incredible. I could hardly think it would reach such a figure, but the most careful consideration leads me to that conclusion.

955. (Chairman.) It seems to indicate two or three or four gallons a week being consumed by heavy drinkers?—Yes, quite that, or even more.

956. (Dr. Whitelegge.) Can you give any reason for the observed cases being so much more numerous in the Mill Road Infirmary?—The only explanation I can give is that at the south end of the town a large number of beer shops—public-houses—are in the hands of a brewer whose beer was not contaminated. At the same time this same brewer has houses elsewhere, but I am inclined to think that that is the explanation. I can think of no other explanation. Then you must remember also that the Mill Road Infirmary perhaps serves a larger and more populous district than either of the others. Those two causes may explain it perhaps.

957. (Professor Thorpe.) You give in your *précis* the names of the brewers whose beers were examined during October, 1900?—Yes.

Arsenic
Beer in
the ep

958. Have any of the products of those breweries been found to contain arsenic subsequently?—Yes.

959. Will you tell us which?—The beer of seven firms was examined then.

960. You are prepared to give us the names of brewers whose beers were found to be arsenicated after October, 1900. You have given us the names of certain brewers, samples of whose beer were examined in 1900. Now I wish to ask you if some of them were subsequently found to be arsenicated?—Yes.

961-2. Will you tell us the names of those brewers?—They are the first, second, and sixth on the list.

963. (Chairman.) That is after October?—Yes, on or about the 25th or 27th November.

964. But they might have been arsenicated in October, as the tests made in October were not decisive as against arsenic?—Yes.

965. (Professor Thorpe.) There is nothing to lead you to suppose there had been any change in their procedure?—No.

966. The presumption therefore is that their beers in October would have contained arsenic?—It is quite likely, although it would be well to bear in mind that, in taking a number of samples of beer brewed by the same brewer, some of them were arsenical, and some

were not, so that it is a mere inference as to what the condition was in October.

967. These brewers would be using malt substitutes prior to October, would they not?—Yes; I should think there is no doubt about that, but I do not know it of my own knowledge.

968. Were they customers of Bostock's to your knowledge?—Yes.

969. Were they customers of Bostock's prior to October, to your knowledge?—I should think they were; I think there is no doubt of it, but I have not been told so. They have been for some time customers of Bostock's, and I think I may safely say that they were customers of Bostock's before October.

970. Of course, the analyst in taking these samples would have nothing to guide him as to the origin of the beer?—The analyst receives his samples from my own officers, and he has nothing to guide him as to the source from which the beer comes. It is given him in the usual way, with a number on it. The sample is sealed up with a number attached, and he knows it by the number, and reports upon it by the number.

971. Of course, there is nothing in the appearance of the beer which would lead him to infer that it had been made from a malt substitute, or that it was not wholly the product of malt and hops?—I should not think so.

972. (Chairman.) Did your officer get the samples from the breweries or from the publicans?—From both sources.

973. (Professor Thorpe.) But not prior to October?—No; the October samples were all taken from shops under the provisions of the Food and Drugs Act.

974. (Chairman.) Will you explain what you as a medical officer of health are allowed to do under the Public Health Act?—It appeared to me to be the first and imperative duty to stop the sale of the arsenical beer in the promptest possible manner. Had we proceeded under the Sale of Food and Drugs Act, we should have taken a few samples, ten or a dozen, it may be; they would have been sent to the analyst for presumably a quantitative analysis, and on receipt of his report it would have been necessary to give notice to the person who sold the beer that in fourteen days an information laid against him would be heard. The delays which would necessarily have been involved by such a procedure might have resulted in the consumption of arsenical beer for another fortnight or so, and if that consumption had taken place the amount of mischief would have gone on and increased during that time. Therefore, it appeared to me that action under the Food and Drugs Act was altogether too slow to deal with an emergency such as that with which we were confronted. At that time we did not know whose beer was contaminated. The brewers themselves did not know; in fact, we were absolutely in the dark as to which of the 2,000 odd public houses were selling poisonous beer, and it was our business to find that out at the quickest possible moment. Therefore, I instructed the inspectors to obtain as large a number of samples as the analyst could deal with, and I requested him to report to me forthwith whether or not there was any arsenic present, irrespective of the quantity. So that, instead of having to wait for a fortnight or more before taking action, we were able to take action within a few hours. The action we took was to cause a meeting of the Brewers' Association to be called together, and to intimate to them as soon as we knew ourselves that their beer was either contaminated or suspected. The brewers in the meantime—many of them—had employed their own analysts, and in some cases received information as to the character of their beer before our own analysts were able to give it to them, and as a consequence, within a very few days a considerable quantity of beer was poured into the sewers. The amount of which I received official information was 257,522 gallons.

975. What does the Public Health Act allow you to do?—Another course open, and which occurred to me to put into application, was the Public Health Act, which would enable us to seize the contaminated beer. But there were two difficulties in the way of that application, one being that the beer was not offered for sale, and another that we had no evidence as to which of the many barrels were contaminated and which were

not, and until we had some such information we could not put that Act into force. The promptness of action on the part of the brewers, who themselves were extremely anxious, of course, to get rid of this poisonous stuff, resulted in ridding the city in a very few days of the main bulk, at all events, of the arsenical beer. I have prepared some tables, which indicate the date of the purchase of the sample, the date at which the informal report was received from the analyst, the date at which the official report was received, and the earliest date upon which proceedings could have been taken under the Food and Drugs Act, had we elected to adopt the course of procedure only under the Food and Drugs Act. I should like to call your attention to one instance—they are all alike—but I should like to emphasise the point by referring to one. On the 27th November six samples were taken. On the following morning, the 28th November, the informal report was given to me by the analyst as to which of them contained arsenic. I received his official certificate on the 6th December, and it would not have been possible under the Food and Drugs Act to have taken action before the 21st December. So that by the course we adopted we dealt with the arsenical beer in a few hours, within a day, but under the Food and Drugs Act, 24 days would have elapsed before we could have taken any case before a magistrate.

976. Then this early action was done by the aid of the brewers and by the brewers?—It was done partly by the brewers; they were perfectly willing to take this course, and to empty away any suspected beer. If they had not been willing we should of course have taken proceedings against them 24 days afterwards.

977. Under the Food and Drugs Act?—Yes. We should have taken proceedings against the person who sold the beer, not the brewer; against the licensee—some old woman in a back street, it may be, who had absolutely no means of knowing the quality of the stuff she was selling.

978. With regard to this 258,000 gallons that were destroyed, were they destroyed chiefly in the breweries, or did the brewers recall the beer from the publicans to whom they had sold it?—It was chiefly in the breweries, but they did recall some from the publicans, and they did empty away out of the publicans' cellars quantities of beer without taking it back to the breweries at all.

979. (Dr. Whitelegge.) It was all destroyed by the brewers and not by the publican?—It was all destroyed by the brewers. I should like to make that point plain, that many of these public houses are the property of the brewers. They are tied houses, and sell only that particular brewer's beer.

980. (Chairman.) Is the beer in these public houses the property of the brewers?—Yes, in some cases, but not in all.

981. And the publicans are merely the selling agents of the brewers?—In some cases; perhaps in the majority of cases they are merely the selling agents.

982. (Professor Thorpe.) Does this 257,522 gallons include what was destroyed on publicans' premises?—Yes, it includes all that I have knowledge of—all that I could get reliable information of.

983. The brewers themselves furnished you with that information?—Yes; but in some cases I have independent evidence that it was quite correct information.

984. The greater portion, no doubt, would be what was destroyed in the breweries?—Yes, in the breweries. Perhaps it is only right to say that it was not all contaminated; it was all suspected, but at least in one instance I could quote, samples of it which were taken before it was turned out were subsequently found to be free from arsenic. What I wish to show is that the brewers were willing to spread their precautions as widely as they could, that there was no hanging back on their part in ridding themselves of this beer.

985. Can you say the same equally of the publicans?—In one or two cases the publicans kept the beer on their premises with a view to recovering its value, I understand. Without saying anything about it, they kept it there—a most improper proceeding.

986. In the case of the publican, surely if being offered for sale, or presumably offered for sale, you could seize and take proceedings to punish the publican?—The inspector received information of it in this particular case, and he forthwith went to the place and had

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Actions
under F. and
D. Acts must
be taken
against
retailer.

Destruction
of Beer.

Contaminated beer
kept on
publican's
premises.

Dr. E. W. Hope. it all emptied out. Possibly it would have been a wiser thing if he had seized it and taken proceedings to punish the publican who had kept it there, but it was not offered for sale, and it was in a part of the premises which prevented it being offered for sale, I believe.

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987. Then under what Act did you proceed—under the Public Health Act?—We would have proceeded under the Public Health Act in that case to seize the beer and to have it dealt with by a magistrate as unfit for human food.

988. (*Chairman.*) Are you referring to the Cornbrook Brewery Company?—Yes, that was one.

989. Were there others?—There was one other.

990. What is the name of the other?—It was in the Netherfield Road. I do not remember the name. It was a house owned by a private publican, and not a house which was restricted to the sale of one particular brewer's beer.

991. And some of the beer in this publican's house was contaminated?—Yes.

992. And some not?—And some not. Instead of emptying away what he had reason to think was contaminated he had set it aside in order to recover the value from the brewer without any intention of selling it. That was his statement.

993. (*Professor Thorpe.*) Was it a Liverpool brewer from whom he got it?—Yes.

994. Had there been any difficulty, or did he apprehend any difficulty, in getting back the value from the brewer?—I do not think so. I never heard such a suggestion.

995. (*Chairman.*) Was that improper if he took absolutely rigorous measures to avoid its being sold to the public?—I would not trust him. As an official I should say it was an improper thing to have it on the premises at all.

996. (*Professor Thorpe.*) Was the brewer with whom he was dealing one of those brewers who voluntarily destroyed their beer?—Yes.

997. So that he would have had no difficulty?—He would have had no difficulty at all if he had gone about it in the right way. I suppose some dispute arose, and this man held back, and did not have the beer turned out.

998. (*Chairman.*) Did he apply to the brewers?—The brewers informed my officer of it, and the officer went forthwith and had it all turned out.

999. (*Sir William Church.*) With regard to these 260,000 odd gallons of beer that were destroyed, do you know how many firms that affected?—Twelve firms, I believe.

1000. (*Chairman.*) You have the names of all those firms?—Yes.

1001. (*Sir William Church.*) Are any of those twelve among the seven breweries whose names we have had, where the beer was tested in October?—Yes, the first one and the second one; only these two.

1002. I notice that these two firms are local firms; that is so, is it not?—They are not essentially Liverpool firms. I think they are Salford and Manchester firms principally, but they have large establishments in Liverpool also.

1003. Have you any idea of the proportion of beer which is furnished by what I may call the local breweries, and those which are not local, such as Salt's, Guinness's, and Bass, which you have mentioned in your table?—No; I cannot give you the relative amounts or proportions of beer sold by these firms, but I think on the whole it may be said that the local firms sell the most.

1004. I suppose the last one on the list is one of the largest purveyors of beer in Liverpool?—Yes.

1005. Therefore the incriminated beers, the beers in which arsenic was found, were all what might be called of local firms?—They were local in the sense that their headquarters may be either in Liverpool, Manchester, Salford, or Chester.

1006. (*Dr. Whitelegge.*) The beer of the sixth firm on the list, I think you told us, was found to contain arsenic?—Yes.

1007. Was not that firm one of those who destroyed their stock?—I believe the analyses showed that they

did destroy some, but I have not a return as to the quantity.

1008. You told us that if you had proceeded under the sale of Food and Drugs Act, after a delay of 24 days you would have been able to take action?—Against the persons who sold the beer—the retailer, not against the brewer.

1009. Would that action have had the effect of causing the destruction of the beer or merely the infliction of a penalty?—It would merely have inflicted a penalty, and nothing else, upon the retailer, the person who had handed the glass of beer over the counter.

1010. Were all your samples at that time taken from retailers?—At the beginning they were all taken from retailers.

1011. Did you take any samples with the formalities under the Sale of Food and Drugs Act from breweries?—No.

1012. Do you think you have power to do so?—No; I do not think we have power to do so under the Sale of Food and Drugs Act.

1013. (*Professor Thorpe.*) Arising out of that, in case a brewer is made to give this warranty, or chooses to give on demand a written warranty, would you not have power?—I believe so. We might then proceed against the person giving the written warranty; but I never heard of a brewer giving a written warranty in any case.

1014. That is possibly the way now?—Yes; I think it would be a most desirable thing that something of that sort should be done. It is a most important thing.

1015. You are aware, doubtless, that in the case of large milk distributors, middlemen, and even farmers, they are frequently obliged to give warranties?—Yes.

1016. And in case a retailer is brought into the police court, he can plead the existence of his warranty, and then the wholesale man can be made a party to the suit?—Yes; that is frequently done.

1017. There is no real reason why that should not be done in the case of beer, is there?—I hope that will be done in the future. I was intending to refer to that matter later.

1018. (*Dr. Whitelegge.*) But in that case would you rely upon the sample taken from the retailer, or would you take samples from the brewery?—I should like to see the powers extended very considerably, and I propose to make suggestions on those very points, that powers should be given to obtain samples from breweries, and also samples of the materials from which the beer is manufactured.

1019. We will come to that later. I want to make it clear at this stage whether you think, as matters stand, that you have powers to-day to take samples from breweries under the Sale of Food and Drugs Act?—I do not think we have. The sale of Food and Drugs Act essentially implies a sale, but in breweries they do not, or rather they may not, sell anyone a glass of ale.

1020. (*Mr. Cosmo Benson.*) Have you power to take samples from any manufacturer of food, not a retailer, under the Food and Drugs Act?—No, not under the Food and Drugs Act, I think.

1021. We will take such foods as those advertised for infants, and so forth; have you any power to go to the manufacturer and take samples?—No.

1022. Only from the retailer?—Only from the retailer.

1023. (*Dr. Whitelegge.*) You have told us that in proceeding under the Public Health Acts in the case of a brewery there would be difficulty of identifying the contaminated beer?—Yes. The difficulty of ascertaining that it is contaminated without the power of first going to get a sample, which we do not possess.

1024. And ordering its retention, I suppose?—Yes.

1025. And coming back in a fortnight?—Yes.

1026. You have no effective power of the kind, I presume?—No.

1027. And in the absence of those powers the Public Health Act does not materially help you in the case of breweries?—It would only help us in this respect, that if we had reasonable ground for suspecting the beer upon a certain brewery had been contaminated with arsenic, we should not hesitate to seize it and have it dealt with by a magistrate, because, as I say,

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1029. Would you expect the magistrate to condemn it then and there?—In the meantime we would have had an analytical report upon a sample of it. It would only take a few hours after the seizure.

1031. Is the Public Health Acts Amendment Act of 1890 in force in Liverpool?—Yes.

1033. You spoke of "analysts" in the plural: is there more than one public analyst in Liverpool?—Yes, we have two chemical analysts and one bacteriological analyst, all under the Sale of Food and Drugs Act.

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per
ved.

1036. Have you given us the number of breweries in Liverpool?—There are 60 different beer-selling firms, not 60 breweries.

1038. (*Professor Thorpe*. Do you mean wholesale beer-selling bodies, or retailers?—Wholesale and retail.

1039. (Mr. *Cosmo Bonsor*.) Either brewers themselves or their agents in other parts of the country. The point is this, that in one house the beer of any manufacturer is sold; I look upon that as one distinct and separate agent. This one agent may himself have a dozen or more houses in which he carries on that same kind of business. Then, on the other hand, there are very large numbers of houses tied to principal brewers, in which no beer except that of the principal brewers is sold, unless by agreement. But we have samples from 60 separate and independent sources, and the table I have submitted relates to those 60 firms.

quite know what the legal aspect of the matter would be. But in prosecutions that I have heard or read of the person proceeded against is the actual retailer—the person who actually sold the beer.

1041. But if you go into a shop under the sale of Food and Drugs Acts and buy an article of food which is eventually found to be wrong, you do not proceed against the assistant who sold it?—You do in some cases.

1042. But is not the usual plan to indict the actual owner of the premises?—Yes.

1043. Why should not the brewer be brought under the same category if he is the actual owner of the tied house?—Because the brewer is in the same category as the manufacturer—we will say—of golden syrup, or of a mixture of what is called “French coffee.”

1044. But he is both the manufacturer and the seller?
—He may be, but not necessarily.

1045. (Mr. Cosmo Bonsor.) The licensed holder of a public-house is the responsible person, is he not?—Yea.

1047. The licensed holder is not the brewer!—That is

1048. (Chairman.) Have you experienced any diffi- Difficulty in culty in getting beer analysed?—At the commencement getting beer of the arsenical poisoning epidemic we had considerable analysed.

of the arsenical poisoning epidemic we had considerable difficulty, because the various laboratories were so full that we were obliged to limit the investigation and restrict it to determining whether or not there was arsenic present. We found that that was the best way of employing the time of the analyst. The brewers themselves were sending large numbers of samples from all parts of the country, and the various laboratories in Liverpool were quite overtaxed with making analyses of beers. So far as the city analysts were concerned it would not have been possible for them to have examined one-tenth of the number of samples for quantitative analyses which were dealt with in the way I have described.

1049. Was the source of the arsenic traced?—Yes, very speedily. It was traced to glucose and invert sugar, manufactured by Messrs. Bostock. Messrs. Bostock are sugar refiners, in Garston, which is a few miles from the boundary of Liverpool; they are not within the city. Bostock's works outside Liverpool.

1060. Returning to the subject of public analysts, P. Analysts is it customary for public analysts to examine samples and private in their private capacity?—Yes; I believe there is no samples. restriction.

1051. Do they habitually or frequently do so?—Yes; I believe that under the Sale of Food and Drugs Act they may be called upon to do so. Upon the payment of a fee they are required to make an analysis for any person who asks them.

1052. Under the terms of a public analyst's appointment, has public work the first claim upon his time?—I do not know whether the terms of his appointment require it; but as a matter of practice, public work has the first claim upon his time.

1053. We should like to know the total number of samples, and the dates, and so on?—The total number of samples taken from 60 different firms is shown in the accompanying Table. Arsenic or traces of arsenic to a varying extent were found in the beer supplied by 20 of those firms.

The sequence in time and the proportionate number of samples found by the Public Analysts to be contaminated are as follows :—

	Number of Samples taken.	Number found con- taminated.	Remarks.
1900 :			
During October . . .	10	0	
From 27th Nov. to 3rd Dec.	76	25	Contaminated to a greater or less extent, some being duplicates.
From 4th to 10th Dec. -	135	23	Contaminated, nearly all slightly, some being dupli- cates.
From 11th to 17th Dec.	65	4	Contaminated to the extent of a minute trace.
From 18th to 24th Dec.	11	0	
From 25th to 31st Dec.	4	0	
1901 :			
From 1st to 7th Jan. .	10	0	
From 8th to 14th Jan. -	22	0	
From 15th to 21st Jan.	38	0	
From 22nd to 28th Jan.	18	0	
From 29th Jan. to 4th Feb.	10	2	
From 5th to 11th Feb. -	10	0	
From 12th to 18th Feb.	4	0	
From 19th to 25th Feb.	4	0	

Dr. E. W. Hope. The extent of contamination of these samples is shewn in the following additional table:—

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PARTICULARS relating to implicated Firms.

Firm of Brewers, Identifying Numbers.	Number of Samples taken.	Number found contaminated.	Remarks.
2	12	1	Doubtful.
4	5	1	Doubtful.
7	20	2	1 — trace. 1 — doubtful.
11	11	3	1 — $\frac{1}{2}$ grains. 1 — small quantity. 1 — 1-14th of a grain.
13	14	3	A quantity of arsenic.
14	14	8	1 — $\frac{3}{4}$ of a grain. 3 — $\frac{1}{2}$ of a grain. 1 — 1-7th of a grain. 1 — 1-9th of a grain. 2 — a small quantity.
20	10	3	2 — a quantity of arsenic. 1 — 1-14th of a grain.
22	3	2	A trace.
24	20	3	1 — 1-12th of a grain. 1 — 1-15th of a grain. 1 — a trace.
28	6	1	Doubtful; trace.
31	13	1	$\frac{3}{4}$ of a grain.
36	13	4	1 — $\frac{1}{2}$ grains. 3 — a quantity of arsenic.
38	14	3	1 — 1-13th of a grain. 1 — 1-13th of a grain. 1 — a quantity.
39	10	3	1 — $\frac{1}{2}$ grains. 2 — a quantity of arsenic.
45	4	1	$\frac{1}{2}$ grains.
47	15	6	A trace.
48	9	1	A quantity of arsenic.
51	33	1	Doubtful.
53	2	1	A trace.
60	12	1	A trace.

1054. (*Dr. Whitelegge.*) Are the firms brewers?—Not necessarily. Out of 237 samples taken from the 20 firms, 52 were found to contain arsenic. Of the remaining 40 firms 178 samples were taken, and all of them were found to be entirely free from contamination.

1055. Do you understand that to mean that they had no trace of arsenic whatever?—Yes.

1056. Could you tell us the terms of the analyst's certificate? Were these samples pronounced to be "genuine," or was it expressly stated that they contained no arsenic?—In some cases it was expressly stated that they contained no arsenic; in other cases they were stated to be "genuine," and in others "genuine" or "passable."

1057. Were they all taken for the special purposes of your inquiry?—Yes.

1058. And were they all taken within the knowledge of the analyst in order to ascertain the presence of arsenic?—Yes.

1059. (*Chairman.*) I see in the table, in some cases "a quantity of arsenic," and in other cases the quantity is stated; does "quantity of arsenic" mean more than a trace?—Yes. The analyst gave me his definitions as well as the maximum quantities. The largest amount of arsenic was $\frac{1}{2}$ grains to the gallon. That amount, I think, was found in four samples. Four samples contained $\frac{1}{2}$ grains to the gallon, 2 contained $\frac{3}{4}$ of a grain, 3 contained $\frac{1}{2}$ a grain; 18 contained "a small quantity," which the analyst defines from 1-10th to 1-12th of a grain; 25 contained "a mere trace"—something under 1-50th of a grain; and 363 were certified as "genuine."

1060. (*Sir William Church.*) I see there is a heading "doubtful" in your table?—Yes. In 25 samples there was "a mere trace," amongst which may be included some "doubtful" ones. The remainder, 363, are certified "genuine."

1061. (*Chairman.*) With regard to "a mere trace" of arsenic does that mean anything up to 1-12th of a

grain?—No; much less than that, so the analyst informs me.

1062. (*Dr. Whitelegge.*) But what becomes of the intermediate figures? If more than 1-50th and less than 1-12th, in which group would it go?—This would range from 1-15th or 1-20th or 1-100th of a grain, to a quantity as to which it would be very doubtful whether there was any or not.

1063. (*Professor Thorpe.*) Would any of these be included in the 25 samples?—Yes.

1064. (*Chairman.*) I see many entries, "a quantity of arsenic"; does that mean a quantity less than 1-12th of a grain? In one case I see "a small quantity," and in a large number of cases I see "a quantity"; might that be a large quantity?—A "large quantity" would be something like $\frac{1}{2}$ or $\frac{3}{4}$ of a grain. The report would have been made before any quantitative estimate had been made.

1065. Would not the analyst explain the meaning of the entry, "quantity of arsenic," as distinguished from the other entries?—Yes; he gives a definition of those expressions, but I cannot put my hand upon it at the moment.

1066. (*Professor Thorpe.*) I suppose some of the phrases, such as "a quantity," "a small quantity," and "a large quantity" would have reference to a preliminary statement which the analyst made to you in order to enable you to act promptly?—Yes, that is so. The maximum quantities are stated in the tables in actual amounts, so that, however he describes it, you would know that there were not more than four samples with $\frac{1}{2}$ grains per gallon, nor more than two with $\frac{3}{4}$ of a grain, nor more than three with $\frac{1}{2}$ a grain. The other quantities, however they are described, are below those. As a matter of administrative importance, I should like to mention that these bad samples were among the earliest that were taken. The Table I have already put in indicates the numbers taken during the first week.

1067. (*Chairman.*) I presume we shall have the analyst before us, who will explain these entries?—Yes. The only other point I wish to mention is that the worst samples taken were among the earliest, and as days went on we found a gradual disappearance of this arsenical beer.

1068. That was after the alarm had been given, I presume?—Yes.

1069. (*Sir William Church.*) Can you tell us what time you think elapses between the manufacture of the beer and its delivery to the retail houses?—A very short time, I believe—a week or so. Probably in a week or ten days the brew would be consumed. It is not stored on the premises for any length of time.

1070. So that beer brewed this week would probably be placed at the public-houses for consumption within a fortnight?—I should think so.

1071. (*Chairman.*) We should like to know the names of the brewers to whom these identifying numbers correspond?—I will hand in the whole sixty names, together with the results.

The following Table was handed in:—

BEER.

COMPLETE PARTICULARS relating to FIRMS, Free and Implicated.

No.	Firm.	Number of Samples taken.	Number found contaminated.	Remarks.
1	Allsopp's	9	0	
2	Barker	12	1	Doubtful.
3	Bass	14	0	
4	Bate & Sons	5	1	Doubtful.
5	Beardhills	1	0	
6	Bell, John	2	0	
7	Bent's	20	1	Trace doubtful.
8	Birkenhead Brewery	2	0	

Beer consumed soon after brewing

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COMPLETE PARTICULARS, &c.—continued.

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No.	Firm.	Number of Samples taken.	Number found contaminated.	Remarks.
9	Bleazard - - -	5	0	
10	Bramley & Sons - -	9	0	
11	Burton Bell & Co. -	11	3	1 = 1½ grains. 1 = small quantity. 1 = 1-14th grain.
12	Burton Brewery Co. -	1	0	
13	Cain's - - -	14	3	A quantity of arsenic.
14	Cornbrook's - - -	14	8	1 = ½ grain. 2 = ¼ grain. 1 = 1-7th grain. 1 = 1-9th grain. 2 small quantity.
15	Evershed's - - -	1	0	
16	Findlater's - - -	2	0	
17	Gartside - - -	2	0	
18	Gatehouse - - -	2	0	
19	German Lager Beer Company.	1	0	
20	Glover and Sons - -	10	3	2 a quantity of arsenic. 1 = 1-14th of a grain.
21	Greenhall, Whitley -	9	0	
22	Groves and Withnall -	3	2	A trace.
23	Guinness - - -	7	0	
24	Harding and Parrington	20	3	1 = 1-12th of a grain. 1 = 1-14th of a grain. 1 = a trace.
25	Heyes - - -	1	0	
26	Higson's - - -	7	0	
27	Hill's (Burton) - -	1	0	
28	Houlding's - - -	6	1	Doubtful. Trace.
29	Ind, Coope & Co. - -	13	0	
30	Jeffreys - - -	1	0	
31	Jones - - -	13	1	½ of a grain.
32	Joplin - - -	8	0	
33	Kensington Brewery -	1	0	
34	Lager Beer Company -	2	0	
35	McEwan's - - -	1	0	
36	Montgomery's - - -	13	4	1 = 1½ grains. 3 a quantity of arsenic.
37	Rigby's - - -	10	0	
38	Mellor's - - -	14	3	1 = 1-13th of a grain. 1 = 1-12th of a grain. 1 = a quantity.
39	Robinson's - - -	10	3	1 = 1½ grains. 2 = a quantity of arsenic.
40	Salt & Co. - - -	5	0	
41	Showell's - - -	1	0	
42	Smart's - - -	13	0	
43	Smith, Mumford's - -	5	0	
44	Smith, Tadcaster - -	2	0	
45	Tarback's - - -	4	1	1½ grains.
46	Tetley's - - -	1	0	
47	Threlfall's - - -	15	6	A trace.
48	Thoroughgood's - -	9	1	A quantity of arsenic.
49	Tower Brewery Co. -	1	0	
50	Treeman's - - -	4	0	
51	Walker's - - -	33	1	Doubtful.
52	Walker's Peter - - -	5	0	
53	Watson, Woodhead - -	2	1	A trace.
54	Webster - - -	1	0	
55	Webster & Atkins - -	9	0	
56	West Cheshire - - -	2	0	
57	Whitbread - - -	1	0	
58	Whittle Spring's - -	10	0	
59	Worthington - - -	3	0	
60	Yates - - -	12	1	A trace.

1072. Can you tell us anything with regard to the arsenic in malt?—Traces of arsenic were found in malt used by Liverpool brewers or destined for their use, but in relatively small quantities as compared with the arsenic in the glucose.

1073. I see among the analyses here 4½ grains to the pound is mentioned. Is that in one sample of glucose?—Yes.

1074. In another case I see 9½ grains of arsenic to a pound of glucose?—Yes, that is Bostock's glucose. The analyst estimates that the first sample would represent from one-third of a grain to one grain of arsenic in a gallon of beer, and presumably the second one would represent double that amount.

1075. (Dr. Whitelegge.) Are both these Bostock's sugars?—Yes.

1076. (Chairman.) Does that assume that all the arsenic reaches the finished beer?—That assumes the liability to contamination.

1077. (Professor Thorpe.) Was that estimate of the amount of arsenic in the glucose deduced from the composition of the beer, or was it a direct determination from the glucose?—A direct determination from the glucose.

1078. (Mr. Cosmo Bonser.) Were the samples of malt which were analysed taken from brewers or maltsters?—I understand they were taken from maltsters, but the analyst could give you all the details as to that.

1079. (Chairman.) Have you any quantitative statement as to arsenic in malt?—No, the traces are very minute.

1080. Have you examined the process of the kilning in the manufacture of malt?—I may say that I am aware that the presence of arsenic is attributed to the coke or coal used in the kilns in drying malt, and that it may be easily removed, so I am informed, with the dust by screening.

1081. Do you think it is safe to have grain coated with arsenic, and then the arsenic brushed off afterwards?—No, I think it is most undesirable.

1082. You are not an expert in malting, and you cannot say whether the process of roasting or whatever it is, could be conducted without exposure to the fumes of the fire?—I should think it is perfectly easy to prepare the malt without arsenical contamination. If it were not so, the presence of arsenic would be more frequent, and from the fact that the arsenic in the malt is relatively infrequent one must see that it is not necessary that it should be there. With proper care and precautions the presence of arsenic can be avoided.

1083. That is a precaution as to the fuel?—Yes; but it is better that it should never be there rather than that it should be removed afterwards.

1084. But you do not know whether the process could not be conducted so as to bring about the same result without exposure at all to the fumes of the fire?—I have only the broad fact that the malt is as a general rule prepared without arsenic, and if it can be avoided in some cases it can be avoided in all.

1085. As it is, it is always exposed, I believe, to the fumes; and the use of proper fuel, not containing arsenic, is the only safeguard at present?—I believe that is so.

1086. What have you to say with regard to the question of a negligible minimum of arsenic in beer?—It has been suggested that in some cases the arsenic present is so minute in quantity that it may be altogether neglected, that it can have no material effect upon the public health, and that its presence is of no consequence. I think myself that is an extremely bad view and a very improper one. In my opinion, there should be no arsenic at all in beer, and it appears to me that there is no necessity why there should be any. It is the exception to find it. If beer in ninety-nine cases out of a hundred can be manufactured so as not to have any trace of arsenic, it should always be so manufactured. I also think that the smallest quantity of arsenic may be productive in certain cases of great mischief to the beer drinker. I think it properly deserves its name as a deadly poison, and that no quantity of it should be allowed in a beverage or in a food.

1087. Then you are of opinion that even a trace of arsenic discovered by chemical test should condemn the food or the beer containing it?—Yes.

1088. (Sir William Church.) Have you formed any opinion as to the action of arsenic upon man in very

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Quantity of arsenic in glucose.

Arsenic in malt.

No arsenic should be allowed in beer.

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small quantities, either in conjunction with alcohol or not, when taken for a long period; do you think it has a cumulative effect?—Yes, I believe it has. This recent epidemic clearly shows that a prolonged use of minute quantities has resulted in maiming, in serious illness, and in death. I think those facts are established by the recent epidemic.

1099. Can you give us your views with regard to the elimination of arsenic from the body?—My views on that matter, I think, would not be better than those of any other medical man.

1090. I believe in Manchester the cases were more fatal among women than among men?—That has been our experience in Liverpool also.

1091. Have you any explanation of that?—It may be that the men are stronger to start with—that their constitutions are stronger—that they are leading more active lives. I can give no other explanation than that.

1092. You have no view as to the fact except that probably the men lead more active lives, and that, therefore, probably their skins act more freely than in the case of women?—That is the only suggestion that I have by way of explanation—that by the active, laborious lives which the men lead they may have got rid of it. Cases, however, have come to my knowledge in which I have asked the poisoned woman what her husband had to drink, and I was told that he had had exactly the same as she had had, and as much to drink, or even more, and that he had escaped poisoning. It is a very curious thing, but that seems to be so.

1093. Are the proportionate figures between the sexes latterly the same as they were formerly before the poisoning by arsenic was suspected?—No; there is an increase in the number of women poisoned.

1094. But with regard to the alcoholic neuritis, I suppose there were more fatal cases in women than in men?—Formerly there were more cases of men, but latterly there have been more cases of women. Then, of course, there is the fact that Addison's disease, as you know, was assigned as the cause of death in several of these cases, which have since been shown to be arsenical.

1095. That arose from the pigmentation?—Yes. Last year there were seven deaths certified to be due to Addison's disease. Five of them were females. The average of the preceding five years was only two deaths per annum from that disease.

Pigmentation.

1096. Had pigmentation ever been noticed in connection with neuritis before last year?—I think not. I never heard of it being observed.

1097. In your experience you would say that pigmentation was not met with in what used to be termed alcoholic neuritis?—It had never been noticed or mentioned, and I never saw it.

1098. Therefore these cases, quite apart from the other evidence of arsenic, differed from the ordinary cases of alcoholic neuritis or multiple neuritis, in that a large proportion of them were more or less pigmented?—That is so.

1099. In Liverpool was any increase of sickness and diarrhoea noticed before there was a suspicion of poisoning by arsenic?—No, there was absolutely nothing at all to attract attention beyond those cases of neuritis.

1100. Nothing came to your knowledge as Medical Officer of Health?—Nothing at all.

1101. Do you know whether most of those cases did suffer from gastric symptoms at first?—No, I do not. They were under the care of Dr. Raw, who, I believe, will appear before you.

1102. (Chairman.) Do you know whether the beer drinkers themselves began to find that beer disagreed with them before the public scare took place?—There was no sickness attributed to beer. If the beer drinkers felt they were getting ill they had no idea what it was that was making them ill.

1103. We have heard that at Manchester and at Salford the beer drinkers began to give up drinking beer in many cases, finding it did not agree with them. Have you any definite experience as to that?—That was not our experience.

Effect of
arsenic and
alcohol to-
gether.

1104. (Dr. Whitelegge.) Do you consider that alcoholism renders a person more liable to arsenical poisoning?—I think so. It struck me that it did. It appeared to me that the two things combined seemed to modify the action of each other.

1105. Did the 100 cases you examined more particularly bear out that view?—Yes.

1106. (Mr. Cosmo Bonser.) You stated just now that you considered that beer should be manufactured absolutely free from arsenic. I presume you not only refer to beer, but to any article of food?—All articles of food. What applies to beer would certainly apply to other articles of food.

1107. (Professor Thorpe.) Of course, that statement Tests must have reference to some test for the arsenic?—Yes, arsenic Beer.

1108. I mean the thing must be subject to a chemical test?—Yes, you must be able to determine the presence of arsenic by chemical means. I know of no other means.

1109. So that the absence or presence of arsenic is defined by the test?—Yes.

1110. How is the analyst, therefore, unless the test is prescribed for him, to certify whether arsenic is there or not?—But he himself is the best judge. He uses the most approved methods of determining the presence of a poison, and we are in his hands. If he certifies that the substance is free from arsenic we are satisfied with that.

1111. Again, I would point out to you that every test after a time breaks down, because to every test there is a certain degree of sensibility attached. A man may be incapable of detecting arsenic in a gallon of beer, but he might be able to detect it in a barrel of it?—Well, if for analytical purposes he needs a barrel, we shall be pleased to secure a barrel for his researches. We would not limit the amount of the sample which we would give to him.

1112. But as a practical matter could an inspector under the Sale of Food and Drugs Act obtain quantities of beer of that order?—Yes, if it were necessary. We frequently get very large quantities of articles of food.

1113. Would it not be rather a *reductio ad absurdum* for a man to go into a public house and say, "I want a barrel of beer," and after buying it declare that it was for the purpose of analysis and have it divided into three parts; or, if a barrel was not enough for the purpose of analysis, to get three barrels, one of which he would leave with the publican, one he would take away, and the other give to the analyst?—If we are going to make analyses of such enormous quantities as that we should, if necessary, probably get the samples from the brewers. But our analysts say that one gallon is ample for their most minute test.

1114. That is for a particular test, but though a test for arsenic might break down for one gallon, it might be effective in a test with 10 gallons?—I do not know. I have no evidence whatever to lead me to think that that would be so. All things are possible, but that seems extremely unlikely.

1115. What I want to make clear is this, and I have no doubt you will recognise it. Your statement as to the absolute absence of arsenic may have no real value, because it is solely in relation to a particular test which may be applied to a particular quantity of material?—Anyhow, it seems to me that the tests are better applied in a laboratory than on the human subject. In this case a gigantic experiment has been tried upon human beings with very serious results. If we could obviate a repetition of such a thing by sending the analyst a gallon or even a barrel of beer we should be extremely glad to do so. There would be no difficulty about it.

1116. Have you formed any opinion as to what Quantity amount of beer these tests which are known to you Beers should be made upon?—I know quite well that the for pu infinitesimally minute quantities that you suggest may of P. a exist, might want a large amount of beer for their Acis. detection. But for all practical purposes, for all the purposes of ordinary human affairs, the analysts so far say that a gallon is enough; they say that if we send them a gallon that is enough for their purpose.

1117. So that, if you continued to operate under the Sale of Food and Drugs Act, you would require to take 3 gallons of beer for the purpose of analysis?—Yes.

1118. And that you think, with such tests as you know of, it ought to be reasonably sufficient in the interests of public health to check the possibility of arsenical poisoning?—Yes, I think so.

1119. (Dr. Whitelegge.) You say that you came to the conclusion, after conference with the public analyst, that a gallon is sufficient?—Yes.

1120. I want to be quite clear about this. Does that mean a gallon purchased, of which one-third goes to the analyst, or does it mean 3 gallons purchased,

of which one gallon goes to the analyst?—No; the analyst requires 1 gallon, so that we take 3 gallons.

1121. But you say in some cases a gallon was purchased?—Yes.

1122. But I understand you have gone beyond that now?—We took less usually; the usual quantity was a quart, but that was not enough for the detection of excessively minute quantities of arsenic, and, therefore, we took a gallon, and ultimately 3 gallons, for the purposes of closer investigation.

1123. As a matter of routine practice?—Not as a matter of routine practice, but to meet this specific emergency.

1124. So next year, and the year after, according to your view, if samples of beer are taken for analysis, it would be necessary to make 3 gallon purchases?—I do not think that would be necessary in all cases, nor as a routine practice. I should confer with the analyst again upon that, but so far as my present information goes, I do not think in all cases we should need to take those large quantities.

1125. (Chairman.) Generally a gallon would suffice, you think?—Yes, or even less.

1126. (Professor Thorpe.) Do you think that buying such large quantities of beer would in any way tend to defeat the object of your enquiry?—It would be a very serious obstacle, and, as I have suggested, we should probably have to get it either from the brewers, or adopt some other means of procuring it. It may be that the Sale of Food and Drugs Act, or some other

Act in reference to it, may be amended as a consequence of this wholesale spread of illness, and this very serious loss of life. I hope it may be, to enable us to meet an emergency such as this.

1127. Doubtless you are aware that sometimes inspectors have a difficulty in working the Sale of Food and Drugs Acts if they or their agents ask for anything unusual?—Yes, that is a difficulty.

1128. For example, in the case of milk, if they ask for a quantity which indicates that three portions are being required, that in itself arouses suspicion?—Any unusual quantity may arouse suspicion and no doubt it does sometimes, but that is a difficulty we meet as best we can, and we must do it. It is not an insuperable difficulty.

1129. You do not apprehend any serious difficulty in the case of beer from the fact of asking for three gallons, do you?—No, I think we should manage to get them in some way, from some sources. After all, the presence of a poison in the beer is a matter of infinitely more consequence than is contemplated by the Sale of Food and Drugs Act. It appears to me to be frivolous and trifling that a person who has sold a deadly poison is punished only to the extent of a fine of something like 20s. and costs. That seems to me extremely frivolous.

1130. (Chairman.) That fine you would say is rather designed to check operations which comparatively are quite innocent?—Yes, quite so.

[The Chair was here taken by Sir WILLIAM CHURCH.]

1131. (Chairman.) Might I ask you to give the Commission the benefit of the conclusions that you have arrived at?—The conclusions that I have arrived at are, in the first place, that the exceptional sickness and mortality owing to arsenical poisoning have been due in Liverpool to poisoning through the medium of beer, that beer was the means by which the arsenic reached the poisoned person. The arsenic found its way into the beer from an impure glucose, and the arsenic in the glucose was due to the use of sulphuric acid containing arsenic in large quantities. Bostock's firm, as is well known, supplied the glucose, and it is equally well known that Messrs. Nicholson, of Leeds, supplied Messrs. Bostock with sulphuric acid containing arsenic. For many years Messrs. Nicholson supplied a pure acid, and, without any warning or communication with Bostock's in any way, they substituted acid containing arsenic for the pure acid.

1132. Is it within your knowledge that they supplied pure acid to Bostock's?—Yes, I have heard it stated upon oath at the coroner's court that for many years they supplied a pure acid, that they ran short of the pure acid (as I understand), and they substituted the arsenical acid. But it is only right to them to give their explanation, namely, that they did not know what business Messrs. Bostock's carried on. It is true that they addressed letters to "Messrs. Bostock, Sugar Makers," but at the same time they did not know, so they say, what was the nature of Bostock's business. Therefore they felt justified in sending sulphuric acid without going through the formality of enquiry, or warning Bostock's in any way. That appears to have been the ultimate origin of the arsenic in the beer.

1133. Were you present at the inquest when it was stated on oath that it was pure sulphuric acid which had been for some years supplied?—Yes. It was stated on oath that the acid had been analysed from time to time by Bostock's chemist, and found to be pure. In fact, he states that he was thrown off his guard by repeated analyses, and had therefore given up testing it, feeling so much confidence in the purity of the acid.

1134. They did not supply the ordinary commercial brown oil of vitriol?—They supplied an oil of vitriol which was free from arsenic up to a period, and then they suddenly substituted this arsenical acid. Perhaps I may as well mention, as it might interest the Commission to know it, that Messrs. Nicholson distinguished the two kinds of acids, using a red label for the pure acid and a black label for the arsenical acid. But when they made the change in the material, and sent to Bostock's acid containing arsenic, they did not change the

label, but continued to send the acid bearing that label which, in their premises at all events, indicated purity. That appears to have been the source of the trouble. Those facts are all mentioned because I would venture to make one or two suggestions.

1135. Perhaps you will be good enough to make those suggestions?—It appears to me that a very much stricter supervision should be exercised over all the materials used in the manufacture of foods, beer included. That such supervision is necessary I think the facts which I have just mentioned very clearly prove. The manner in which I suggest this supervision should be exercised is somewhat on these lines. Inspections are now carried out by Government departments in other directions, for example under the Alkali Acts, the Factory and Workshops Acts, and many orders of the Board of Agriculture and the Local Government Board, and I am strongly of opinion that some such supervision should be applied to the preparations of food and drink, especially beer, which is so very largely used.

1136. Have you formed any opinion yourself as to whether there is any power for the inspection of the substances used as substitutes for hops and malt in brewing?—I am not aware that there is any power existing which would adequately meet the case. For example, the preparation of an article may take place in the district governed by one local authority, and the sale of it may take place in that under the supervision of another. The authority in whose district the article is sold has at present no power, so far as I know, of going into the district of the authority in which it is manufactured, for samples. The manufacture may take place in a rural district where inspection is very inadequate, as, for example, to quote a familiar instance in the case of cows. The milk is consumed in the cities, but is produced in rural districts. Now, powers are given to most of the great cities to go into the rural districts to make inspections and examinations. Similarly, I think that the Sale of Food and Drugs Act should be so amended as to enable samples of manufactured articles and also of ingredients used in the process of manufacture, to be procured at the place of manufacture or preparation for manufacture, and the officers of the sanitary authority in whose district the manufactured articles are sold should have that power. If an article, for example, is sold in Manchester, I believe that powers ought to be given to the Manchester Sanitary Authority to go, if they so wish, and supervise the manufacture of, or take samples of, the substances used in the manufacture. I do not suggest that that should be anything more than supplementary to the Government inspection, but I think it would be a good thing if those powers were given to the great cities.

Existing powers inadequate.

Government inspection and supplementary inquiries by sanitary authorities of great cities advocated.

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E. W. Hope.

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Question of
warranty.

1137. I think you suggest that brewers supplying retailers, licensees, or managers of public-houses with beer should send with the beer a warranty guaranteeing the purity of the materials employed in its manufacture?—Yes; that is a third recommendation which I would make.

1138. (Mr. Cosmo Bonser.) Do you throw the responsibility in the first place on the manufacturer, and then check that responsibility by increasing the powers of the sanitary authorities or Government inspectors?—Yes.

1139. You are not going to relieve the manufacturer from responsibility?—No. I think recent events show the manufacturers certainly require a very close supervision.

1140. Is there any precedent for manufacturers giving a guarantee in respect of the article supplied in this way?—Yes; it is frequently done.

1141. Could you mention one instance?—One instance was mentioned by Professor Thorpe, in which a milk contractor gives a written warranty certifying the milk to be pure and genuine and wholesome.

1142. But that is hardly a manufactured article, is it; it is a production?—That is so; but the same applies both to butter and margarine.

1143. Under a special Act?—I think so; but it is a very frequent thing for warranties to be produced. We will, if you like, take the case of fruit wines, that would be a very good case in point.

1144. I am not objecting; I only want to know if there is any precedent, as it is a most important matter?—I know that the brewers themselves do employ analysts, and we have had ample knowledge of that. At the same time, the analyses which these gentlemen make are not directed to questions affecting the public health, but to questions affecting the suitability of the materials for the manufacture of the beer. That, I take it, is what they direct their efforts towards.

1145. (Professor Thorpe.) But in this particular case, confining ourselves for the moment to the brewers, is it not now the fact that before a brewer uses any one of these malt substitutes he is taking pains to see that the substitutes sold to him are free from arsenic?—I am quite assured that he wishes to do so, but he has not succeeded; his pains have resulted in nothing. We have the very strongest evidence of that. If his efforts had been successful and adequate there would have been no Arsenical Commission.

Guarantees
of purity of
ingredients,

1146. I am talking of the things which have arisen in consequence. Is it within your knowledge that the manufacturers of these things are themselves taking steps to furnish the brewers with the guarantee of purity?—Probably they are, just now.

1147. Is it at all unlikely that that practice will die down and that those guarantees will not be forthcoming in the future?—I would prefer to see it made obligatory than that it should be optional. I think after this terrible lesson it would not do to leave anything to chance, or to the views and feelings of those who may be engaged in that special business.

1148. But, of course, you have a double check, have you not, in this case? No doubt the manufacturers of invert and glucose will take steps to assure themselves of the purity of the oil of vitriol which they take into use?—They did so before; Bostock's, for example, assured us that their chemist was assiduous in his examinations, but we know that he failed. Our present system has broken down; it is not strong enough; it is not complete enough.

1149. But under your coming system, if I may say so, the question will be after all one of testing?—Quite so. We have very great confidence in Government inspection. We think the employment of more supervision would be attended with very good results.

should be
compulsory,

1150. I wish to make this matter quite clear to you as to what the operations on your suggestion would be. In the first instance, the man takes oil of vitriol; no doubt he will get a guarantee with it. He will take steps to authenticate the guarantee by means of the chemists he employs. He will in addition have to furnish to the buyer of his product a certificate or warranty of its purity?—Why will he have to? He will not have to. He may if he likes, but he is not obliged to. What we want to do is to make that compulsory.

1151. Do you think brewers nowadays would take that stuff into use without a warranty?—I do not think he would nowadays, but we have to look to the future.

1152. But I am referring to the future in so far as oil of vitriol enters into manufactured articles. Do you think it likely that the brewer will neglect nowadays such a precaution, and allow arsenic to enter into beer?—Well, no, I do not think he will. But the same remark might be applied to any other question requiring an Act of Parliament: "Do you think that any class of man would do this and that and the other?" Probably the answer would be no, but none the less the Act might be needed.

1153. But prior to this, was it a notorious fact that glucose might contain arsenic? It might be known to one or two persons, or it might be found in a text book, or in an occasional work; but it was not a matter of public notoriety amongst analysts that such might be the case?—Quite so.

1154. And that being the case, do you think it is at all within the region of probability that any relaxation of caution will take place in so simple a matter as testing for arsenic?—I think it is quite likely; I think it might. At all events it is just as well to avert it if we can by inspection and supervision.

1155. Yes; but my point is that your suggestion is not very elaborate, and would require somewhat costly machinery for doing something which there does not seem to be any public necessity to do?—I must answer in this way: I can scarcely think it possible, but if it should be considered that beer itself is an unimportant article of consumption, the same Act might be made to apply to all articles of food with very great advantage, so that we should protect other things in which glucose, etc., may be used, and which have hitherto been free, and which are free to-day, but which may be contaminated to-morrow. We do not know.

1156. But I suppose the same warranty as to purity would attach to any sample of glucose if it were known that it is derived incidentally from sulphuric acid?—There are manufacturers of all grades and importance with works of various sizes, and it is as likely as not that some of the smaller ones would very quickly forget about this calamity. In fact, to-day almost, arsenical beer is being sold; it is an extraordinary fact, and I would like to know how you would explain that? It simply shows in my view that there is a necessity for some very strong supervision.

1157. No doubt arsenical beer has been sold from time immemorial, and it is only the accident of a certain large quantity of arsenic getting by mischance into Bostock's glucose that has created this trouble?—Possibly, and it is in order to avert a repetition of these very grave circumstances that I would recommend these precautions.

1158. (Chairman.) I presume really that the great safeguard produced by the warranty would be that there would be someone responsible who could be come down upon if an article is found impure, and you contend that that is preferable to the present voluntary system, when there is nobody to come down upon?—Yes; at the present time there may not be any warranty at all.

Warrant
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1159. You say that the stipulation of a voluntary warranty may or may not be carried out?—Exactly.

1160. But under the obligatory system if a person's goods do not come up to his warranty he could be come down upon and prosecuted?—Yes.

1161. (Professor Thorpe.) You say that the application of the Food and Drugs Act is limited because you cannot come upon the manufacturer but only upon the retailer of the article?—That is one reason.

1162. What I want to get from you is the machinery by which you can make use of the provisions of the existing law to effect what you want. You could have gone for the brewer, I understand, if the publican had had a warranty?—Yes.

1163. Is there anything to prevent any publican who has a free house from requiring a warranty from a brewer?—There is nothing to prevent him asking him for it.

1164. And he can refuse to deal with that brewer if he does not get it?—He can if he likes, but probably he would lose his own business if he did so.

1165. Why?—There may be a demand for that particular kind of article which is sold there, and he cannot get it with a warranty. On the other hand, there are scores upon scores of houses in which the licence is in the hands of the brewer—the great majority.

1166. I referred to free houses?—Yes, in the relatively few free houses it would perhaps be less difficult for him to get a warranty.

1167. You say it would be less difficult to get the warranty in the cases of the really free houses?—Yes.

1168. He could demand it, and presumably he might get it?—Yes.

1169. In the case of tied houses you want some machinery which connects the manufacturer of the article with the licensee?—Yes; and a warranty, I think, would do that.

1170. Do you not think it might be possible under the existing law, without even the application of a warranty, to connect the actual manufacturer of the article with the sale through his own agent of the substance?—It would be very difficult; it is very difficult indeed.

1171. But the case has never been tested, has it?—Similar ones have, under the section which alludes to a guilty knowledge. It could be tried under that, but you cannot prove what a man's knowledge is. You cannot prove that a man had guilty knowledge that such and such a thing was in the article sold.

1172. You think, do you, that the law requires amendment so as to connect the licensee of a tied house with the brewer?—Yes, distinctly.

1173. (Dr. Whitelegge.) The warranty you think of goes so far as to be a list of the materials employed?—Yes.

1174. It differs from an ordinary warranty under the Sale of Food and Drugs Act?—Yes; in most of those articles the constituents are known.

1175. You would provide for a list of the materials employed, including, in the case of beer, malt and hops, I suppose?—Yes.

1176. And the proportions in which they are used?—I am merely making a suggestion in regard to the guarantee of the purity of the article. I do not think it is so much concern what proportions of ingredients are used, so long as there is a guarantee of purity.

1177. Do you think the guarantee of purity which is obtained from a previous certificate—in the case of Bostock's, for example, from Nicholson—should form the basis of a certificate issued by Bostock's that the ingredients were pure?—Clearly so. The warranty must apply to the manufacturer of the acid as well as to the manufacturer of the glucose, and in turn to the manufacturer of the beer.

1178. (Professor Thorpe.) That was not quite what was in my mind. What I was referring to was an independent warranty. I take it you did not mean that Bostock's warranty should be based upon Nicholson's warranty alone, without any further questioning upon the part of Bostock's chemist?—No. I think it very necessary that their stage of the proceedings should also be supervised.

1179. And you believe that the result should be independently tested by them?—Certainly.

1180. (Dr. Whitelegge.) The warranty given must be based upon the responsibility of the person giving it, and must not be dependent upon warranties received by him from those who supply him with his materials?—Quite so.

1181. Would this system which you suggest protect the individual consumer of an article such as beer?—I think it would.

1182. He would not know anything about the warranty or the list of ingredients, would he?—It might be carried a step further if necessary.

1183. But you think of it as coming down to the retailers?—I think that would be a sufficient warranty arrangement, because the actual retailer would be dealt with directly by the Sale of Food and Drugs Act. The man who sells the article is the one who would be proceeded against in the event of any impurity being present.

1184. You told Professor Thorpe, if I understood you rightly, that if there were a warranty you could proceed against the manufacturers in the case of beer?—Yes; I believe so.

1185. Directly, or after proceeding against the retailer?—After proceeding against the retailer, who would produce his warranty, and that would be a sufficient discharge in his case.

1186. I understood you to recommend that there should be power on the part of officers of the local authority of any district in which the food is consumed to obtain samples from the place of manufacture?—Yes, if they desire to do so.

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1187. Would you make any distinction between one authority and another, or would you extend it to all sanitary authorities alike?—I see no objection to such an extension; but primarily I had in my mind the great cities.

1188. And you would let the samples be taken at whatever distance from those cities?—Yes; anywhere, so long as the article consumed is used in a great city. I should like to see the sanitary authority of that city armed with powers to go into other districts from which the food came, and take samples.

1189. Would not that be difficult in such a case as Bostock's, who supply sugar, I imagine, over a considerable part of the kingdom?—I do not think it would be more difficult than in the case of another article in which the power already exists. It would not be more difficult than is now the case in the matter of milk. It would be difficult unquestionably, and I do not suggest it with the view to relieving any other responsible people from their obligation at all, but merely as an additional safeguard for the great consuming centres.

1190. If Messrs. Bostock supply sugar to a large number of brewers who distribute their beer over a large portion of the kingdom, would that not give a large number of local authorities under the scheme you suggest the right to come at any time and take samples?—Yes, it would.

1191. Does that condition arise under the precedent of milk, which you mentioned?—Yes, certainly.

1192. A large number of local authorities have the right to take samples of milk from a particular farm?—Yes; Manchester, Liverpool, Leeds, and other places might all be sending down to one farm, there is nothing to prevent it.

1193. (Chairman.) I think you wish to make some further suggestion for consideration as to the repeal or modification under Section 3 of the Sale of Food and Drugs Act of 1875?—There is always a difficulty in the administration of Section 3 of the Sale of Food and Drugs Act in proving that the person summoned had any knowledge of the composition of the article mixed or sold; and the question of whether that clause could be amended or modified in any way is what I wish to call attention to. I have nothing further to say about it. It is a clause which is exceedingly difficult to deal with—in fact, it is very seldom that any proceedings are taken under that section. It is an impossibility to prove what a person knows and what he does not know.

1194. (Dr. Whitelegge.) Does anything occur to you short of actual repeal of the section of the Act—Section 5—which requires guilty knowledge to be shown in the case of proceedings under Section 3?—No. The phrasing of Section 6 is a very much simpler one, "If the article is sold to the prejudice of the purchaser." The absence of proof of guilty knowledge is no defence in proceedings under that section, and it is very much more useful and simple one than the other. It is, perhaps, a lawyer's question, but it is one which we find great practical difficulty in working.

1195. (Professor Thorpe.) Have you brought any cases in Liverpool under Section 3?—No.

1196. What has been your fate when you brought them under Section 6?—I have not brought them before the magistrate. They were laid under Section 3. They were not taken before the magistrate at all.

1197. Have you not taken any action under the Sale of Food and Drugs Act at all?—No final action.

1198. You are waiting for the decision in the Manchester appeal cases, are you?—No; we have withdrawn our cases. We were advised by our legal advisers that they were cases which should be withdrawn.

1199. Do you know on what grounds the withdrawal was made?—There were several grounds.

1200. Can you state them?—The difficulty of proof of guilty knowledge.

1201. They were brought under Section 3, then?—Yes.

1202. Were they all intended to be brought under Section 3?—Yes, and there were other grounds also.

1203. Why did you not proceed under Section 6?—The cases in which we had laid informations related to samples taken at the very commencement, in connection with which it was obvious that there was no guilty knowledge on the part of the brewers; and therefore the cases

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Great cities should have power to deal with food manufactured outside their own areas.

Difficulty of applying Section III. of F. and D. Act of 1875.

No prosecutions under F. and D. Acts in Liverpool in respect of arsenical beer.

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were withdrawn under the advice of our legal department. They were cases of samples taken very early, which had long been disposed of, and they were taken at a time when no one knew—neither the brewers or anyone else—the source of the arsenical contamination. In that case I was guided altogether by the law officers of the Corporation.

1204. Do you yourself see any difficulty in bringing a case under Section 6, namely, that it is not of the nature and substance and quality demanded?—We might have done that; but it did not commend itself to me as appropriate or suitable to institute what would practically be a bogus prosecution against some innocent person, when we ourselves knew what was the source of the mischief, and knew perfectly well that these people against whom we might have proceeded were absolutely uninformed and had no knowledge and no means of knowing.

1205. I am not going into the ethics of the case at all, but the point you had in view was to stop the sale of this article?—Exactly; and that is what we did.

1206. How? Only by the voluntary action of the people?—It was stopped within two or three days; whereas by any action under any existing law it might have gone on for three weeks. Our object as a sanitary authority, as a body guarding the public health, was to guard the public health, and that we did effectually in the way I have already described.

1207. But you would not have hesitated to bring a milk-seller into Court under Section 6, would you, although he had no knowledge that the milk he was selling contained water?—That is an entirely different thing. One is fraud—a perennial fraud, day after day and year after year—that is a common fraud; whereas this was a thing without precedent. At that time it was regarded in the light of an absolute accident.

1208. True; but with much more dangerous consequences?—Therefore it was more promptly dealt with. If it were an offence, it was not an offence that could be adequately dealt with by a fine of 20s. inflicted upon an innocent person.

1209. The object there was not to get a fine, but to attain publicity. The fine is not a deterrent so much as the taking of police action, which would be followed by a legal decision, you hoped, in your favour. That is what you wanted, to secure a conviction with a view to stopping the sale of these articles?—The only point was that we stopped the sale of it several weeks before it would have been possible to have obtained a conviction. We do not think it worth while to bait a trap for publicans with human lives. Our object is to act at once.

1210. (Chairman.) You say the work of the authorities of large towns would be enormously facilitated by the enactment of recommendations such as you propose—that is, that the officers should have powers to go into the districts where the manufactured article is sold. You seem to lay great weight upon that?—Yes; I think that would be a very valuable power.

Poisonous
substances
should be
labelled.

1211. And make it compulsory that manufacturers sending out substances containing poison should label them?—Yes, should so label them; and also that it should be the duty of the manufacturers of food stuffs to ask for and use materials free from poison, that they themselves should look out for that point on their own account.

Question of

1212. (Dr. Whitelegge.) Have you had any experience of proceedings on warranty after proceeding against the retailer?—Yes.

1213. Have you been successful in them?—Yes.

1214. Would it be convenient if under a different law the manufacturer could be associated in the first hearing when a warranty is about to be produced?—I think it

would. I think it would save time and simplify things very considerably.

1215. (Professor Thorpe.) With reference to the last suggestion in your *précis*, that manufacturers sending out substances containing poison should label them, how is that going to touch the oil of vitriol maker, supposing he labels his oil of vitriol "Poison"? Oil of vitriol, *per se*, is poison?—Yes, I thought of that. It is obviously poison—corrosive, and no one would think of drinking it. At the same time, if it contains something which it ought not to contain—an additional poison which could find its way into food products, in connection with which sulphuric acid is to be used—then he should so label it. In fact, I can see no harm in his labelling it "Poison," even if it is pure acid. He can then label it "Pure sulphuric acid"—that is to say, label it what it is.

1216. What you want to do is to differentiate between deleterious sulphuric acid, so to speak, and the pure article?—Yes.

1217. Why not at once say "sulphuric acid containing arsenic," or "sulphuric acid free from arsenic"?—Yes, that is an admirable suggestion. I simply put it in its broadest way.

1218. I venture to think that it is not sufficiently distinctive to put merely "Poison." It does not cover what you wish it to cover?—Quite so.

1219. (Chairman.) I take it that these recommendations of yours do not apply to any particular body. They are general to everyone, I presume?—That is so, as well as to this specific subject.

1220. (Sir William Hart-Dyke.) Would you suggest that in each case the purchaser should ask for a guarantee of purity?—Yes.

1221. Do you think that security would be the outcome of that demand alone or do you think the purchaser in such a case should have better protection in any further way than by this simple demand, because you may ask for a thing and not get it?—Quite so. My suggestion is to impose upon him the obligation of asking for a pure thing, letting the manufacturer of sulphuric acid know what the acid is required for. If that is an obligation which rests upon the purchaser it is one more safeguard between the sulphuric acid manufacturers and the public.

1222. Has it not been indicated with reference to this catastrophe and loss of life that Messrs. Nicholson were not aware for what precise purpose this material they were selling was to be used?—That is what they say.

1223. It has been urged, has it not?—That is their statement, that although they supplied Bostock's with pure acid for 10 years they did not know what Bostock's business was, although letters from Nicholson are addressed "Messrs. Bostock, Sugar Makers." They say they did not know what Bostock's were; but without warning or without troubling to inquire what their business was they substituted the arsenical acid for the other.

1224. Made from a different and vitiated source, and hence the disaster?—Yes.

1225. You think if Messrs. Bostock had been compelled by Act of Parliament to state for what purpose this material was to be used this disaster might have been avoided?—Yes. I also think that it should be a primary recommendation that manufacturers sending out substances containing poison should so label them. If the sulphuric acid, which in itself is poison, contains arsenic it should be so labelled. Then the person who receives it will know what there is in it, and he will guard himself. These two recommendations are safeguards upon both sides.

1226. It would be a two-fold safeguard on the part of the vendor and the vendee?—Quite so.

Dr.
E. W. Hope,
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Labelling
poisons.

Responsi-
bility of pur-
chasers of
food ingredi-
ents lies
to be poi-
sons.

Sir WILLIAM HART-DYKE in the Chair.

Mr. ALFRED GORDON SALAMON, Vice-President of the Society of Chemical Industry; Member of Council of the Institute of Chemistry; Consulting and Analytical Chemist; called, and Examined.

A. G. 1227. (Chairman.) You are a vice-president, are you not, of the Society of Chemical Industry?—I am.

Mr. 1228. And a member of the Council of the Institute of Chemistry?—I am.

1229. You have also been the consulting and analytical chemist, with considerable practice and experience, spreading over 17 years, of the technology of brewing?—Yes.

1230. May I ask you how this connection came about with regard to the technology of brewing. Have you been employed much by the brewing trade?—Very largely employed by the brewers throughout the country to advise them as to the best materials to employ for arriving at satisfactory fermentations in connection with the barleys they have to employ.

1231. But most of the large brewers employed their own analytical chemist, did they not?—I am consulting chemist to many large breweries.

1232. For instance, you might be summoned by any one of those whom we may call for the moment your clients, and they might rely on your services at any time?—They consult me with reference to any questions connected with the technology of their work.

1233. And you claim to be not only an analytical chemist, but a specialist, as regards the brewing trade?—I think I may fairly claim that.

1234. You have kindly had printed for us a statement of the principal points on which you would like to give information, and I think you will admit the first two or three pages refer chiefly to things which lead up to your being summoned by Mr. Groves when this serious state of affairs occurred at Manchester?—They bear upon the history of the epidemic as showing the steps which were taken by Mr. Groves and subsequently by his colleagues to unravel the mystery and arrive at the truth in respect of the poisoning.

1235. As a result a committee of experts was appointed, was it not, to advise the Manchester brewers as to what they should do in the emergency?—It was.

1236. Mr. Groves will be shortly giving evidence here, so I do not propose to question you so much on all these earlier stages which you go through in your *precis* which led up to this enquiry; but I think I may put it briefly by asking you whether Mr. Groves, having suspected something seriously wrong with regard to his beer, immediately sent samples to you on November 17th to be examined, on the supposition that some poisonous form of alcohol was present?—Yes. At that time he had reason to believe that the beers contained an undue amount of what are termed the higher alcohols, that is a comprehensive term embodying a great many substances, and he asked me to test the beers to see if I could find those alcohols present in the particular samples.

1237. On December 22nd did you receive an intimation from him that there was a grave suspicion that there was arsenic?—Yes.

1238. That the mischief which caused this great alarm on his part was not occurring from the higher alcohols you have mentioned, but was proceeding from the actual presence of arsenic in the beer?—That is so. With your permission I will hand in the letters.

1239. But other substances did come under suspicion, did they not? Was not there a suspicion on his part at one moment that some poisonous ingredient had got into the beer through the medium of hops?—The first suspicion was that the arsenic was introduced by the hops; it had been stated that a hop merchant in Manchester, who was not a beer drinker, had developed symptoms of poisoning, and it was assumed he had done so through handling the hops. That was subsequently disproved.

1240. That was clearly disproved, was it?—Clearly disproved.

1241. That any mischief accrued from the hops?—Yes.

1242. Then you were informed that there was a strong suspicion as to brewing sugars, and upon analysis you

round arsenic in samples of these sugars there were sent to you from Messrs. Groves and Whitnall's brewery?

—Mr. Groves brought up samples of all the raw materials he employed in his brewery, and as soon as he stated that there was a possibility of the sugars being contaminated—invert sugar only at that time was supposed to be contaminated with arsenic—I at once proceeded to make analyses, with the result that I soon discovered that both the invert sugar and the glucose of Messrs. Bostock supplied to them was grossly contaminated with arsenic.

1243. You found that at once?—Yes.

1244. Then on November 22nd did you advise Mr. Groves that an expert committee should be appointed, not only to advise his firm specially, but also the Manchester Brewers' Association?—I did that for this reason: Mr. Groves was quite prepared to take the inquiry upon his own shoulders; but I pointed out to him, after reflection, that if any material that he was using in his brewery was contaminated with arsenic, the mischief would probably be widespread, and would not be confined to his particular brewery; that if it were a case of malicious addition of any arsenical compound to the beer or materials, it would probably be a case of murder, and I did not feel that I ought to take upon myself the responsibility of acting alone in such a case, I did not feel Mr. Groves ought to bear an undivided responsibility, and I advised the appointment of a Committee to investigate thoroughly, with the view to stopping the further spread of the mischief, and I suggested the names of the gentlemen who subsequently agreed to act.

1245. In fact, you wished to cover the whole ground that could, humanly speaking, be supposed to be covered by the supply throughout the district?—Exactly; and to that end I suggested that Mr. Groves should place himself in communication with the members of the Association of Brewers in Manchester.

1246. Who were the members of this expert committee?—The members of the expert committee were presided over by Mr. Fletcher Moulton, K.C., and consisted of Sir Lauder Brunton, Dr. Stevenson, Dr. Luff, Dr. Buckley, and myself. We constituted the expert committee.

1247. Sir Lauder Brunton is a physician, is he not?—An eminent physician.

1248. And Dr. Stevenson has had very large practice as a specialist in poisoning?—He is the most famous of our toxicologists. He and Dr. Luff are chemical advisers to the Home Office, as is well known.

1249. (Sir William Church.) Dr. Luff was also a physician?—Yes.

1250. (Chairman.) You informed us further that this and work by committee commenced its work in Manchester on them, November 29. Have you anything further to say with regard to the progress of that committee, what determination they arrived at, or what steps they suggested should be taken?—The first meeting of the brewers' committee was held at Manchester at 9 o'clock on the morning of the 29th November; that was seven days after the first visit of Mr. Groves to my laboratory. At this meeting we were informed that the poisoning through beer was then known to be widespread, and that it was by no means restricted to any one particular brewery. It was further stated that Dr. Tattersall had made important discoveries as to locating the mischief in the invert sugar supplied by Messrs. Bostock and Company, of Liverpool, and that Messrs. Groves and Whitnall had further proved it to exist in the glucose supplied by the same firm. When I compared the analyses which I had made—they were numbered samples—with the references which Mr. Groves then supplied me, I found that this absolutely agreed with my own observations, and therefore we had strong *prima facie* evidence that the mischief might be located in respect of the invert sugar and the glucose supplied by Messrs. Bostock and Company.

Then a long discussion followed as to the means to be adopted for combatting the mischief, more especially with respect to the prevention of its spreading. Dr. Luff, and Dr. Buckley then left to inspect the hospital

Mr. A. G. Salamon.

6 Mar. 1901.

Appointment of expert Committee by Manchester Brewers' Association.

taken from the evidence and on every of the in at Sal-

Mr. A. G. Salomon. cases, it being arranged that the gentlemen should, if possible, meet me and be present at the meeting of the Manchester Brewers' Association, which we had been asked to attend.

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I duly attended the meetings, first of the Committee specially appointed to report to the Association; and, secondly, the meeting of the Association, which was very largely attended. In my opinion fully one hundred were present.

The meeting was addressed by the chairman, Mr. Rothwell, who then invited Dr. Luff and myself to speak with a view to suggesting what measures, and particularly what preventive measures, should be taken. I then stated that this was evidently a case of widespread poisoning of a terrible character, and that to prevent further poisoning of the public, vigorous united action by the brewers was indispensable. I stated that the investigation had thus far proved that the brewing sugars recently supplied by Messrs. Bostock and Co., Limited, were poisonously contaminated. I could not then state what other materials were not also contaminated. I did, however, state that it was evidently the duty of the brewers to place an embargo upon all beer in the manufacture of which Bostock's sugar had been employed, to recall such beer, and to destroy it if found to contain arsenic. Further, it was their duty to organise a system of testing so that all beer sent out for consumption should be certified as free from arsenic. I asked that to this end they should place themselves unreservedly in the hands of their Committee, who would be advised by the Expert Committee, and that each brewer should permit the Committee or any of its members to visit each or every brewery to take samples and inspect plant, casks, beers, and materials employed. Dr. Luff strongly supported my demands. We then withdrew and the meeting deliberated, and we were shortly afterwards informed that the meeting had by resolution given full effect to the recommendations, and had pledged itself to faithfully carry them out. I cannot too strongly insist before the Royal Commission upon the genuine loyalty with which the Manchester brewers have redeemed this pledge.

On the same afternoon I had a prolonged interview with Dr. Tattersall, and subsequently with Dr. Niven, from whom I received most important information. Meanwhile, the other members of the Committee were proceeding to investigate independently on their own respective lines.

1251. How many breweries are represented on the Manchester Brewers' Association?—I believe they number some 50 odd. I believe there are about 150 members, including those connected with the trade.

1252. Both of Manchester and Salford?—Yes. But I think the brewers number about 50.

1253. Would that 50 be restricted to Manchester and Salford alone, or include Liverpool, for instance?—I do not think it goes to Liverpool, but it goes outside Manchester, because I have had samples from members of the Association sent to me from other parts than Manchester.

1254. That might indicate a little alarm on the part of those who did not belong to the Association. They need not have sent those samples simply because they belonged to the Association?—I mean samples sent as members of the Association.

1255. Did any recommendations emanate from this Committee with respect to any other brewers outside Manchester, outside the Association?—Our recommendations were published, in the form of reports which I have here, and presumably they were acted upon by others. I have reason to believe they were. Appendix No. 5.)

and reports.

1256. They appeared in the public Press?—Yes. Publicity was given to our recommendations at the earliest possible moment, with the view to getting them widely acted upon.

1257. And there being a general alarm amongst the public and in the trade at the time, it would be natural that intelligence of that kind would be eagerly read?—That was the view of the Association.

1258. Any hint given to the Association at that period would be a hint to the public and the trade, a kind of general caution?—Quite so.

1259. It says in your *précis* that it was proposed that they should place themselves unreservedly in the hands of their Committee, who would be advised, and that each brewer should permit the Committee or any of its members to visit any brewery. Of course, that being agreed to would only apply to the Association?—That only ap-

plied to the Association. It included, as far as I know, Mr. all the brewers of Manchester. Sala

1260. When all these matters were published, it would not throw that incubus on other brewers except the brewers of the Association?—No; but it did include all the brewers of Manchester and district, as far as I know. 6 Mar

1261. You had some 15 samples handed to you, did you not, by Dr. Tattersall for investigation, and you made a careful analysis of them?—Yes. Dr. Tattersall gave them to me at the meeting which I had with him on November 29th, with a letter of identification stating that he had obtained them from Messrs. Bostock and Company, Limited, of Garston. He stated they represented the raw materials which were being employed both at the time of his visit on the 23rd in the manufacture of glucose and invert sugar, and also the finished products as they were being sent to the brewers. He further told me that portions of the above samples had been removed for the purpose of analysis. The samples were delivered by him to Professor Delépine for the purpose of analysis and he handed to me those portions which had not been used. I then made careful analysis of these sugars and raw materials. I soon arrived at the conclusion that the materials which were grossly contaminated with arsenic were invert sugars and glucose. The other raw materials employed, and enumerated by me in the list, were not contaminated with arsenic, with the exception of the sulphuric acid employed in the manufacture of the invert sugar and the glucose. I soon found that this was very dangerously loaded with arsenic. I have here a sample of some of the acid I took, about a dessert spoon full of the acid. I precipitated the arsenic contained in it as the yellow sulphide of arsenic. This was diluted in order to obtain the proper precipitation, and the specimen will show the contamination of that acid which was employed for the manufacture of the invert sugar and of the glucose. (*Specimen exhibited.*) Arsen Boston sugars

1262. These raw materials all emanated, did they not, from Bostock's firm?—I was so assured by Dr. Tattersall.

1263. The Commission do not wish to bind you to statements in regard to researches which are not yet quite completed as regards analysis and other matters, but in part of this document you have kindly sent us you indicate that you would like, perhaps, to be further examined in regard to certain researches you are now making?—I should, because my analyses are not complete, more particularly with respect to the traces of arsenic and the proper means of quantitatively determining those traces.

1264. I think it would be useful at this time if you could give this information to the Commission, as to the highest and lowest quantities respectively of arsenic you have found in any of these raw materials of Messrs. Bostock?—As regards the sulphuric acid, I found the determination of the arsenic a matter of considerable difficulty with the view to arrive at uniformity of result, because it was so loaded with arsenic that the arsenious acid precipitated came out as a copious deposit. I regret that the Coroner has the sample of acid at Liverpool, and I am not able to show it to you. I hope I may be permitted to show it at a later stage. The arsenious acid has crystallised out, and kept on crystallising out, from the acid, and therefore it made it difficult to determine with uniformity what percentage of arsenious acid was present in the sulphuric acid, but it may be taken that my results varied from 0.99 per cent. to 1.7 per cent. of arsenious acid. As regards the glucoses, they varied from 0.04 per cent. to 0.07 per cent. Quant acid,

1265. (*Professor Thorpe.*) What are limits in the case and B of the glucose?—From .04 per cent. to .07 per cent. glucos

1266. (*Sir William Church.*) The sulphuric acid was practically speaking a saturated solution of arsenious acid?—Indeed it was. Perhaps I may be permitted at this stage to show some specimens which will bring home to the minds of the Commission the extent to which these sugars were contaminated.

1267. (*Chairman.*) I think we had better conclude and in first the quantities found. What do you say with sugar, regard to invert sugar?—They varied within similar limits. The samples I have examined of Bostock sugar, both the samples of Dr. Tattersall and the various breweries from which I took them, varied considerably, as might be expected, and I find that the limits I have given will fairly cover them all.

A. G. Salomon. 1267*. (Professor Thorpe.) Do you say that the amounts in the invert were the same as those in the glucose?—Substantially; they varied a good deal.

ar. 1901. 1268. But they were the same?—Between the same limits.

nic in use and sugar pared. 1269. That is surely not what one would expect, because the same proportion of sulphuric acid is not used in the two processes?—There was probably less, on the whole, in the inverts than there was in the glucose, but they varied very much. In all cases they were dangerously loaded with arsenic.

1270. But as a practical matter, only about one half of the oil of vitriol would be used in the manufacture of the invert than in the manufacture of the glucose?—That would be so.

1271. Therefore you would expect the amount of arsenic to have relation to the oil of vitriol used?—That would depend on the condition of the animal charcoal in the manufactory at the time the invert was made. The animal charcoal absorbed a very large proportion of arsenic in the process; that we ascertained at a later stage.

1272. (Sir William Church.) During the filtration of the glucose?—Yes.

nic in chester. 1273. (Chairman.) You said that you were supplied by Dr. Tattersall with the list of the different breweries in Manchester?—I was.

1274. Which were supplied, previous to the detection of the epidemic, by Messrs. Bostock and Company?—And also by Dr. Niven.

1275. Is that list practically complete?—I believe it to be complete.

1276. I think we should be anxious in any case to have the names of these brewers whose beer was found to be arsenical?—Perhaps you will permit me to hand them in?

1277. Yes. You have your samples, and I presume you will have no difficulty in giving the names. Would you take it that the samples sent to you and examined by you were sent as specimens that would be sent to each one of these brewers in Manchester?—I do not quite follow you.

1278. My point is this, that you had a large number of samples from Messrs. Bostock and Company that were being sent out; you examined these samples, and you found a certain number of them contained a great amount of poisonous matter. I understand now that you detected that the beer supplied by these different firms was also poisonous?—I visited these various breweries.

1279. How do you differentiate between those breweries in Manchester which were selling beer that had a poisonous ingredient in it at the time of this epidemic, and those which did not?—By analysis.

1280. By analysis of each?—Yes. I visited these various breweries, and in many cases I took samples myself, and in other cases the samples were sent to me, and they were distributed amongst my colleagues of the Committee and we analysed them.

1281. (Professor Thorpe.) Had you reason to know that these samples which were obtained by Dr. Tattersall from Messrs. Bostock were being distributed to the various breweries?—I had.

1282. (Chairman.) There were two analyses, one of the raw materials from Messrs. Bostock, and the other, which was, of course, the important one, of the actual beer being sold by every brewer in the Association?—He handed me a list of the customers supplied in the Manchester district by Messrs. Bostock and Company, which list he had obtained from them at the time of his visit, and he marked certain names of brewers on that list, out of which clinical cases had arisen, and investigations were proceeding in respect of these clinical cases. I found that list was confirmed and somewhat expanded by Dr. Niven subsequently, and then I confirmed the experience of these two gentlemen by the analyses which were made of the beers that came from these breweries in question.

1283. (Sir William Church.) Is that the 18 breweries you refer to in your *précis*?—Yes; there were 18 breweries in Manchester supplied by Messrs. Bostock and Company, and out of those, eight breweries had cases traced to them of arsenical poisoning.

1284. Do you mean traced by the Medical Officer of Health from the symptoms?—Traced from the symp-

toms, and subsequently confirmed by analysis. But they were traced in the first instance by the symptoms.

1285. (Chairman.) Did you find that all the brewers who had been supplied by Messrs. Bostock had arsenical beer on their premises?—I think I may say that all the 18 brewers who were thus supplied had their beer contaminated with arsenic, but not in all cases was it poisonously contaminated. In some of the cases there were only traces, because they were using a very small proportion of Bostock's sugar. It became really a question of a trace which apparently did not give rise to the poisonous symptoms which were traced from the clinical cases. They were not what one would call cases of gross contamination. In only eight out of the 18 was there evidence of gross contamination by arsenic.

1286. (Sir William Church.) I suppose the assumption being that the beers were contaminated in proportion to the amount of Bostock's materials used. But were not other people's materials used also in Manchester?—Yes.

1287. (Mr. Cosmo Benson.) And possibly the mode in which the materials were used?—Certainly.

1288. I anticipate that if a considerable amount of priming with Bostock's invert sugar was used that beer would be more contaminated with arsenic than beer in which only arsenical glucose was used for brewing?—That is so, because during the process of brewing we have found a considerable proportion of the arsenic is eliminated. Yeast notably appears to have the power of absorbing or abstracting a very considerable quantity of arsenic.

1289. (Chairman.) You mention in your *précis* that an examination was made of casks which had previously contained beer, and that scrapings from the casks were taken, and that a very thorough examination was made with regard to the presence of arsenic?—I considered it most important to know that the cask plant had not become impregnated with arsenic.

1290. Would there be any other portion of the plant in the brewery that might require the same examination with the same object?—I did examine it, but the cleansing of the plant of a brewery is so very thorough and complete, and necessarily so, that I found, as I had expected, that the plant itself was in no case contaminated. What I was afraid of was that the casks might become impregnated with arsenic through absorption by the wood, and therefore I divided the test into two phases. I scraped the surface of casks which I knew had contained the poisonous beer, and having done that I made deep cuts into the casks and submitted them to analysis. In no case did I find anything but a negligible trace of arsenic. Therefore one was justified in stating that the cask plant was free, and that they were entitled to continue its use.

1291. You state that the proportion of brewing sugars employed was found to be about 12 per cent. upon the weight of malt as an average quantity. Is it not true that different brewers use different quantities for the same class of beer?—Yes, it varies with the type of barley they employ. If they employ foreign barley they would use less of the brewing sugars; if they employ heavy land barleys they would want to use more. It would vary very much in that respect, and I found a considerable variation in Manchester. On the whole, I found the amount of brewing sugar employed in Manchester rather less if anything than in other parts of the country.

1292. Was that dependent on the saccharine matter to be found in the barley?—Not so much on the saccharine matter as upon the other constituents of the barley malt. It is not used with a view to make up the deficiency of the barleys in saccharine, but more to dilute what are found to be the objectionable constituents on certain barleys for the production of light beers.

1293. I suppose, broadly speaking, you can state of your own knowledge that very energetic steps were taken by the brewers in Manchester when once this terrible discovery was made to call in the beer?—They took the most energetic steps it was possible to take, and in this they placed themselves entirely under the direction of Mr. Fletcher Moulton and the Committee. They organised a laboratory for examination, and every barrel of beer brewed in Manchester by members of the association was submitted by sample to the analyst, Dr. Miller, and his assistants, and no beer was allowed to be sent out until it had been passed by him. All the barrels of beer

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Proportions of Bostock sugar used varied at different breweries.

Greater liability of contamination from priming.

Casks had not been taken up arsenic.

Variations in amount of glucose used by different brewers.

Precautions taken by brewers.

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which were in the hands of publicans were visited, their numbers ascertained, and when it was known that they had been brewed with Bostock's sugar in any shape or form this label was placed upon them, stating that they were not to be sold until further examined. (A copy of the label was put in.) This is a copy of the certificate which was sent out with the brewings when they had been passed by Dr. Miller. (A copy of the certificate put in.) And this is a copy of the form of certificate which was put in the public-house windows. (Certificate put in.)

of beer.

1294. With regard to the calling in of the beer, I presume that a great quantity of beer was destroyed?—I saw thousands of barrels destroyed myself.

1295. Was there any difficulty in getting the trade to return their beer?—Yes; the publicans thought it a sin to destroy such good beer. They frequently stated that.

1296. And they were prepared to risk the consequences?—I would not go so far as that, but I say that the brewers experienced great difficulty in getting the beer returned.

1297. Could the brewers have taken more energetic steps in that regard—could not they have sent round to such licensed victuallers?—They did, and they did more than that when they found there was a difficulty in getting the beer back, and after having insisted upon the label being placed on each cask that was suspected, Mr. Fletcher Moulton drafted a form of letter, which was subsequently sent to all the retailers, stating that they vended such beer at their own risk and peril. After that the beer was returned to the breweries, and it was all destroyed.

1298. Did it begin to come back then?—Yes. Control samples from the breweries were from time to time sent in London to me, and I am in a position to state now that there is no arsenical contamination beyond negligible traces in the beer of Manchester to-day.

1299. Was anything done with regard to the bottled beer that might have been sent out to grocers or wine merchants?—Similar steps were taken, I understand. The measures taken were fully comprehensive in every respect. I may be permitted to add that it required great organisation on the part of the brewers to obtain the recalling of this large quantity of beer and to effect its destruction; and the brewers worked until past midnight many nights to perfect this organisation.

Examination
of
brewing
sugars of
other firms.

1300. You mention that Messrs. Drake and Company, the sugar brokers of Mincing Lane, obtained for you samples of brewing sugars and materials?—Yes. When the committee of experts returned to London it was decided that an investigation should at once be made as to the presence of arsenic in all materials used in brewing, and to this end I asked Messrs. Drake and Company, as independent sugar brokers, to obtain for me, in the ordinary way of business, samples current on the market of all the brewing sugars, and this they did through different sources, and they were then submitted to analysis. I have analysed, I think, 118 samples in all, and, with the exception of Bostock's sugars, I found them to be all free from arsenic, with one exception, and in that exception I found a mere negligible trace. Then I asked Messrs. Drake and Company to secure for me specimens of the sugars which had been made prior to the discovery of arsenical poisoning.

1301. What was the date when Messrs. Drake and Company let you have these samples; was it before or after the 30th of November?—After. It would be about the first or second week in December. They were sending them in from day to day. I did not get them all on one day. It was when we returned from Manchester.

Arsenic
found in one
sample only.

1302. Then these samples were obtained some considerable time after the first alarm about the epidemic?—That is why I say that, having satisfied myself that the samples in current use were pure, I then asked Messrs. Drake to secure for me samples which had been manufactured previous to the epidemic. That they did, and those are recorded in separate analyses. In that case I found the trace of arsenic in one, and in all the others there was no arsenic whatever that I detected.

1303. What about the trace that you found in one case?—It would come within the same category as a trace of arsenic in some of the samples of malt spoken of.

1304. Would it be such a trace as would prove injurious to life?—I could not speak as a medical man

to that; it was not a trace that the medical colleagues of the committee would so consider.

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1305. Not sufficient for that?—Certainly not. It was very minute.

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1306. I believe you are anxious to state something with regard to the guarantees exacted by different manufacturers with regard to the purity of the sulphuric acid employed by them?—We thought it was advisable to inquire how the manufacturers of the various brewing sugars had guaranteed for themselves and the brewers that the sulphuric acid they employed was free from arsenic, and we ascertained that either they used sulphuric acid made from brimstone or sulphuric acid made from pyrites, but so purified that they had a guarantee that it contained no iron, lead, nitrous compounds, or arsenic. I myself inspected several of these forms of guarantee which were given to the manufacturers previous to the outbreak. I then received a letter which was sent to the chairman of the Manchester Brewers' Association, dated the 15th December, 1900, signed by all the makers of brewing sugar in the Kingdom. With your permission I will hand the letter in. It runs as follows:—"The commission appointed by your association in its interim report states that its investigations point to the conclusion that arsenic has been found in certain brewing sugars. In consequence of this announcement, the makers of brewing sugars in the United Kingdom, other than the firm named, have met and discussed the question, and I am authorised in their name to state as follows:—"It is, and always has been, their invariable custom to use arsenic-free acid in the manufacture of sugars. They have never known any other course pursued until the present case. They are ready to permit your commission to verify this statement." Feeling sure that you will give to this important trade the opportunity,—I remain, yours faithfully (Signed) Richard Garton. P.S.—I subjoin the names of the firms in whose behalf I make the above statement. To the best of my information they include the whole of the trade with the exception of the firm mentioned in the interim report of the commission." Then the signatures of all the makers are appended. Those names, of course, do not include the makers of foreign glucose. There is a very large import into this country of American and German glucose, and I may be, perhaps, permitted to state that any recommendations which the Royal Commission may make in respect of the control of these substances would have to include some method of dealing with the purity of imported as well as home manufactured brewing sugars.

1307. (Mr. Cosmo Bonsor.) I believe a few months ago there was a very large importation of American glucose?—There is a very considerable trade in it to-day.

1308. Did you find any sold in Manchester?—Yes, largely. I also found it to be extremely pure. The German product is also quite pure.

1309. You just now spoke of the various samples of sugar which you tested, and in which you only found a small trace?—I only found it in one case.

1310. Could you tell the Commission with regard to that case whether it was one in which imported glucose or home-made glucose had been used?—It was a home-made glucose, but the trace was negligible. I merely mention it because it is only right to give a full account of what one found. But it may be ignored. It is not a case in which one could for a moment consider that it was anything but a negligible quantity as compared with the loaded quantity found in the Bostock sugar.

1311. Have you any idea of the proportion of imported glucose compared with the home-made article?—I could not give you the exact figures, but I could give you figures that would enable you to form an idea. One firm of manufacturers in this country make about 45 per cent. of the total amount used in the country, and another firm make about 25 per cent. of the total quantity used.

1312. (Professor Thorpe.) You mean used by brewers?—Yes, by brewers; I am only speaking of the brewers. The other quantities of imported sugar would be very large. There are six other makers of brewing sugars in this country, including Bostock, and they account for the 30 per cent. balance.

1313. Then 70 per cent. is really in the hands of two manufacturers?—Yes.

1314. And the other 30 per cent. is supplied by the remaining manufacturers plus the foreign supply?—Yes.

1315. (Mr. Cosmo Bonsor.) Is foreign glucose very largely used in the manufacture of ginger ales and that

Precaution
by brewers
to obtain
arsenic-free
acid.

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Imported
glucose.

G. class of drink?—I have reason to believe it is largely used.

1316. Is it in Kops ale?—I could not specify any particular make, but in the manufacture of what are called temperance beverages, which include a large variety of preparations, I know that it is considerably employed.

1317. (Professor Thorpe.) Both German and American?—I should say both German and American. I would not speak positively as to that, but I think so.

1318. (Chairman.) I must ask you a few questions with regard to this very important matter of the test. Although I am very far from an expert in these matters, I must ask you one or two questions which may be supplemented by Dr. Thorpe afterwards. You say that in the initial stage of the inquiry a very severe application was made with regard to test, and it was so stringent that it would frequently not pass a beer brewed exclusively from malt and hops; and you further urge that what really was required in the emergency was a test that would permit the brewers to carry on their trade while at the same time protecting the public. I should like you to explain that statement as far as possible?—At that time we, in common with all other experts, I think, were unaware that malt and other materials used in brewing were apt to contain traces of arsenic or that they did contain them. We advised a very stringent form of what is known as the Reinsch test, which we recommended Dr. Miller to carry out before he passed any of the beer in the Manchester district. When he came to apply that test, he found that he could not pass many beers that were made only from malt and hops, and also beers brewed with admittedly pure brewing sugars. We found that certain indications which analysts not versed in the analysis of beer for arsenic would have taken as indications of arsenic, notably the blackening of the copper in the test, was not due to the presence of arsenic at all, but to certain constituents which might locally arise in the water and in the materials legitimately employed in the manufacture of beer. Therefore we had to modify our test after consultation with the medical authorities, so that we were sure that all beer that went out for consumption would be free, whilst permitting the brewer to carry on his legitimate practice, leaving it to a later period to investigate the question of traces we had discovered, and to deal with them in another manner at a later stage. The test was only intended to be provisional, and it was one which we were assured would adequately protect the public, and we have reason to know that it has done so.

1319. In fact, you dealt with the whole question as a very grave public one, and your chief object was to protect the public in that emergency?—Quite so.

1320. You were rather looking to the future for further investigation?—Yes, with respect to traces.

1321. Which you had never previously suspected?—No.

1322. You further state that, so far as your investigations have gone, you have satisfied yourself that there may be serious indications of arsenic—for instance, that of the blackening of copper, which may be absolutely misleading?—Absolutely so. I should like to show the Commission an instance in point.

1323. The blackening of copper, then, is no certain indication of the presence of arsenic?—No. Here is a blackened copper produced from a beer which does not contain a trace of arsenic. That would be condemned by analysts not previously intimate with the analysis of beer for arsenic. (Specimens exhibited.)

1324. That is the original metal?—Yes.

1325. (Professor Thorpe.) Would not any process which would reduce any sulphuretted compound give that blackening?—Precisely, and that is what it was caused by. It was not previously known to analysts, who would not be versed in the manufacture of beer.

1326. (Mr. Cosmo Benson.) Would that be injurious to health?—Not in the least.

1327. (Professor Thorpe.) Do you mean to say that anybody would bring a charge against a beer on a test of that character?—I would not go so far as that, but I have seen cases in which the blackened copper has been thought quite sufficient indication until we pointed out that it was no indication whatever in connection with beer.

1328. Do you mean to imply that a public analyst would actually bring a case into a police court on evidence of that character?—I would not like to go so far as that, but I have had cases brought before me in which

the analyst had pointed out these blackened coppers as indicating the presence of arsenic in beer. On several occasions I have had such cases, and it was that which led to the necessity of our putting into the report the statement that the blackening was no indication.

1329. (Chairman.) Are you satisfied that you have proved the value of the Reinsch test?—I am quite satisfied that it has protected the public. It was provisionally recommended, but when it came to be worked out more in detail, and one got thoroughly practised in doing hundreds of tests, one found it was much more delicate than one had previously anticipated. Whereas we thought it would protect the public against one part in a million and a half, we now find that, properly applied, it would protect them against one part in three millions, and I am informed by medical authorities that such a trace as one part in three millions, at any rate for the purpose with which we have had to deal with it, is absolutely negligible.

1330. I think there was another distinct case of a large brewery where you had a sample to test, and found it very much contaminated with arsenic?—Yes.

1331. Was this brewery connected with the Manchester Association?—Not in any way whatever.

1332. Was it a Lancashire brewery?—No.

1333. It was distinct altogether?—Yes. They sent me samples of the beer to test for arsenic. I mention it because I applied this Reinsch test, and I at once saw the distinct crystals, and they so much resembled those that I had seen in the case of the Bostock beers, and knowing as I did that this brewery controlled a very large district, I sent them a telegram stating: "Do not on any account send out; report follows." Then I sent them the following letter: "I have very carefully examined the sample of beer you have submitted to me, and regret to inform you that the same is grossly contaminated with arsenic. In my opinion it would be extremely dangerous to allow this beer to go into consumption, and I advise that it be destroyed at once. It is quite as much contaminated as any of the worst samples which led to the grave results in Manchester. I should be interested to know whether you have been brewing with Bostock's sugars. You must please understand that my report is intended to be of a very serious character, and it is my duty to warn you that you will run a very great risk in permitting this beer in any shape or form whatever to go into consumption." Upon receipt of this letter further samples were submitted, representing eight distinct brewings; and on the 14th December I reported: "I regret to have to inform you that each one of these samples contains very notable quantities of arsenic, and that it will be found quite unsafe and even dangerous to send them out. It is my unpleasant duty to have to tell you that, in my opinion, you have no alternative but to destroy these beers. They could never be rendered free from danger." They then gave me the source whence they were obtaining their brewing sugars, and I found it was from an agent of Bostock and Company. My point is that by this test we were able to detect the Bostock sugar in a beer from a remote part of England, and that the test enabled me to telegraph them in terms strong enough to stop them sending out the beer, and to cause it, as I subsequently did, to be destroyed. I had a similar case from a brewery in the Midlands where this same test was applied, and where I again detected what I think I may term Bostock crystals of arsenic.

1334. (Sir William Church.) You merely mean by Bostock's crystals of arsenic a large quantity of arsenic?—A particularly large size, which I could demonstrate if wanted. On inquiry I found Bostock's sugar had been used, and the beer was stopped going into consumption. I therefore point to this fact, that the test which the committee devised did adequately protect the public when properly applied.

1335. (Chairman.) Have you any suggestion to make in regard to safeguarding the public in the future from a disaster such as this which you have described?—I would wish with permission to defer my suggestions until I present a further set of experiments which I am conducting in conjunction with my colleagues, but I may say this, that obviously steps must be taken to prevent any sulphuric acid made through pyrites being used in the manufacture of sugar unless it is previously certified as absolutely free from arsenic and other injurious substances or ingredients, or the acid must be made from brimstone, in which case no poisonous contamination is to be apprehended. But that again involves very serious considerations because of the possibility, unless some

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particular form of brimstone is employed, of introducing other possible complications. Therefore I would ask that my evidence upon this point may be deferred. But I would point to this, that in any steps which may be taken, or any recommendations that may be made, the question of the imported sugar must not be lost sight of, because it would not either be just nor would it safeguard the public to lay down certain restrictions in respect of the manufacture of our home products and not to exact similar guarantees in respect of imported articles.

1336. (Sir William Church.) When first Mr. Groves referred to you did he ask you whether what are called the higher alcohols were represented in the beer or whether there was an undue proportion of them?—He asked me whether they were present in any of them in abnormal amounts.

1337. Have you any information as to the effect of them upon man?—No; I could not speak with authority as to their physiological or their toxic effect.

Brewers' custom to mix their sugars.

1338. I did not quite follow the explanation that you gave of the Manchester brewers using such a mixture of glucose and sugar?—I found to my surprise when I investigated the brewing of the Manchester brewers that they did not only use one manufacture in their breweries.

1339. You say it is to keep up the quality of the manufacture and keep down the price; I do not quite follow that?—I assume that was their reason for using more than one manufacture; but in every brewery I went into I found they were using at least two, and sometimes three, different makes of brewing sugar. They were using, for instance, Bostock's, Garton's, or Manbré's, and an American sugar, and they were mixing them, and I say that that was the reason why this poisoning was not much more widespread than it was. I think the reason they used them was that they kept up the quality of the various makers by letting them all supply a quantity of each make of sugar, and at the same time kept down the price. In that connection may I be permitted to state that I have made an examination of hundreds of invoices of the prices paid for these brewing sugars, and I found that the price paid for Bostock sugar by the Manchester brewers was just as high as that paid to the other makers.

Price of Bostock's sugar.

1340. It was not that part I did not understand?—I should like to be permitted to exhibit these invoices. The price of the glucose was 10s. 6d. per cwt. in the case of the Bostock sugar at the same date as they were paying 10s. 6d. to Manbré's; and I found the same to obtain for invert sugar throughout the various breweries in Manchester. Thus we have established the fact that they were not used for the purposes of economy.

1341. (Mr. Cosmo Bonsor.) I take it most of these sugars are sold through travellers?—I think so.

1342. It is a question of the traveller calling on the brewer, and each traveller gets his order in turn, as long as the price and quality are the same?—I think that must be so.

Arsenic in all-malt beer

1343. (Sir William Church.) Did Dr. Miller report that he could not pass beers which he knew had been brewed from malt and hops only?—In certain cases they would not pass the first test.

1344. Because they were contaminated with arsenic?—With traces.

1345. These, I suppose, were beers that were brewed by firms which had been using Bostock's materials before?—I should say not in all cases; in fact, I know it was not so in all cases. But in many cases it was

found that the best way to get absolute freedom from arsenic was to employ a much larger proportion of brewing sugar than had hitherto been used, and so dilute the negligible trace of arsenic in the malt. The arsenic in the malt is a matter that can be easily dealt with. There is no difficulty in taking the arsenic completely out of malt, and producing a malt that does not contain any arsenic at all. I shall be prepared at a later stage to show the many analyses we have made in connection with that subject and to trace to the very bed rock the reason and origin of the arsenic in traces in malt. But it must not be for a moment assumed that those traces bear any sort of comparison to the arsenic that has been found in these Bostock sugars, and which caused this outbreak.

1346. But still the fact remains that Dr. Miller did find traces of arsenic in this beer? It was not traces of darkening of copper from other substances, but really was arsenic?—It really was traces of arsenic.

1347. Have you formed any opinion in your own mind as to what is a negligible quantity?—I would sooner see none at all, and I think it is quite feasible and practicable for the brewer to brew with malt which contains no arsenic whatever, and I may say that the bulk of beer in the United Kingdom to-day does not contain a trace. It is only when the maltsters employ cheap materials to compete with the taxation of the brewer, the economy they are bound to effect to keep pace with that taxation, that they run into these possibilities; but the malt can be made so that it does not contain a trace of arsenic.

No trace of arsenic in most

No arsenic in malt.

1348. But you would rather not express any opinion yourself as to what quantity of arsenic might be present in beer without being prejudicial to health?—I think, with all respect, that the statements which have been made as to the quantity of arsenic when it deals with traces are most delusive. They are estimates, not determinations. When one finds a mirror such as that, which represents 50 grammes of a malt, and then ventures to state how much that corresponds to in a pint by a comparison with similar mirrors, I do not regard it as accurate work at all. (Specimens shown.) This is 100 times the quantity of one of the Bostock sugars, and by comparing the two you will see the difference.

1349. Are crystals visible by the microscope in both cases?—Not in that case; but I should like to show you some of these specimens. (Further specimens shown.) Here are the coppers that I obtained. Those coppers would represent the arsenic-free coppers of the materials other than the sulphuric acid, and that brewing sugars given to me by Dr. Tattersall. They are free. That represents one of the bad Bostock sugars, and this another. That grey is very typical. If the sublimate is examined under the microscope the crystals are exceedingly distinct. I would very much like to have the opportunity either of handing these to Dr. Thorpe to exhibit to the Commission under the microscope or of exhibiting them myself, because there is something to be learned here in respect of traces. I find that if you take 50 grammes of a malt, and find a distinct trace, and then put it through this test and get it in the form of a sublimate, there is always a minute crystal, as compared with relatively very large crystals which one gets with the test if there are any notable quantities present, such as in the case of the Bostock sugars.

1350. You spoke almost as if you could identify arsenic from Bostock's sugar, but it is only because of there being a large quantity that you get much larger crystals?—Larger crystals, yes.

FOURTH DAY.

AT WESTMINSTER PALACE HOTEL.

Thursday, 7th March 1901.

PRESENT :

The Right Hon. LORD KELVIN (in the Chair).

The Right Hon. Sir WILLIAM HART-DYKE.
 Sir WILLIAM CHURCH.
 Mr. COSMO BONSOR.

Professor THORPE.
 Dr. WHITELEGGE.

Dr. BUCHANAN, Secretary.

Mr. ALFRED GORDON SALAMON, recalled.

A. G. 1351. (Professor Thorpe.) You told us that your first
 communication with Mr. Groves with respect to this
 catastrophe was in connection with a request from him
 to examine the beer for the presence of higher alcohols?
 —Yes.

1352. It would be interesting, I daresay, to the Com-
 mission to know precisely what you did in satisfying him
 as to the absence or presence of the higher alcohols?—
 I have already stated that I only went a very little way
 in the investigation. I had very little time in between
 the request to investigate for the higher alcohols and the
 visit of Mr. Groves and when he informed me by telegram
 that the suggestion was of arsenical poisoning; and,
 therefore, I had not got further than to fractionate. I
 showed Mr. Groves various fractions which I had made
 of the alcohols, and I really did not go further.

1353. Did you identify the higher alcohols?—No, I
 did not; I had not got so far as that. Mr. Groves
 agreed with the idea that any pernicious influence due
 to the presence of higher alcohols would have to be
 abandoned in Manchester, and, therefore, it was un-
 necessary to proceed further with that phase of the in-
 vestigation.

1354. Do you know how the idea that higher alcohols
 had anything to do with the mischief occurred?—I be-
 lieve it emanated from one of the medical authorities
 who was investigating the hospital cases. It was a
 theory advanced to account for the symptoms which had
 been noticed.

1355. You do not know that there is any connection
 between neuritis and the higher alcohols, do you?—I do
 not.

1356. You told us, I think, that you yourself examined
 certain of the products employed by Messrs. Groves and
 Whitnall?—I did.

1357. You examined both the glucose and the invert?
 —Yes, and various other substances submitted to me by
 them.

1358. Does this sample of glucose in any way resemble
 that which you examined? (Handing sample to witness.)
 —It was similar in appearance, certainly.

1359. Did the invert at all resemble this? (Handing
 sample to witness.)—Yes. It was not quite so solid
 when I had the samples drawn from their brewery; but
 that, of course, does solidify, as you know, after the
 sample has been kept.

1360. For all you know, that might be an identical
 sample with what you examined?—Quite so.

1361. Are those good average commercial samples, so
 far as you can tell outwardly, of glucose and invert?
 —Quite; I could not distinguish them from the best
 samples upon the market.

1362. There is nothing in their appearance to indicate
 that they contain any deleterious substance?—Nothing
 whatever.

1363. You said something yesterday about the power
 which yeast has of secreting arsenic. Have you any-

thing to add to what you then stated on that point?—
 You will pardon me for suggesting that I do not think
 I used the word "secreting." I do not know whether
 the action is connected with the development of yeast,
 or whether it is a more absorbent action. The yeast
 in the course of fermentation passes through the whole
 volume of the fermenting wort, and certainly there can
 be no doubt whatever that yeast has the power of ab-
 sorbing considerable quantities of arsenic. I have
 tested the yeasts from all the breweries in the Manches-
 ter Association, and I found that in every case when
 Boetock's sugar had been employed the yeast was very
 considerably contaminated with arsenic. I have found
 from the samples which I have since had that the yeast
 is practically free from arsenic now. I consider that the
 yeast played a very considerable part in the removal of
 a large portion of the contamination, because it reproduces
 to a very considerable extent in the process of fermenta-
 tion, and only a very small portion of that reproduced
 yeast is retained for purposes of subsequent fermenta-
 tion. Therefore, that which constituted the portion not
 so employed had removed a corresponding amount of
 arsenic.

1364. What I should like to get from you, if you have
 considered the question, is whether you imagine that
 arsenic had anything to do with what I may call the
 metabolism of the yeast?—Personally, I do not think
 there is any evidence to show that arsenic is connected
 with yeast metabolism. As far as one can judge, there
 does appear to be evidence pointing to the fact that cer-
 tain ferments or certain fungi of the type of *penicillia*,
 and some *mucorini*, do in the process of metabolism
 assimilate a considerable quantity of arsenic, but I have
 no evidence of anything similar proved to exist in respect
 of yeast. The fungi to which those investigations refer
 are all of the aerobic type as distinguished from the
 anaerobic, to which yeast belongs, and it would be quite
 impossible that such fungi should be present in quantity
 in beer, provided that saleable beer were to be produced.

1365. I think this is a little important, because it may
 throw light upon what I suppose is a difficulty, and has
 been a difficulty, in explaining the action of these pre-
 sumably small quantities of arsenic. I suppose you agree
 with most people that it is a new development in the
 toxicology of arsenic that there should be such wide-
 spread misery apparently caused by such relatively small
 quantities of arsenic?—I cannot speak as a toxicologist,
 but as a chemist it has amazed me.

1366. Of course you are aware that various surmises
 have been made to account for so small a quantity of
 arsenic doing such widespread mischief?—Yes.

1367. Some of these surmises had reference to the pos-
 sible combination of arsenic with substances developed
 by fermentative changes?—Yes, I have heard that put
 forward as a theory, but I have seen no evidence in sup-
 port of the theory up to the present moment. I under-
 stand that certain researches are being made upon it,
 particularly with reference to the possibility of certain
 of the albumoses in beer combining with arsenic to
 form possibly a more injurious arsenical compound than

Mr. A. G.
 Salamon.
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Combination
 of arsenic
 with organic
 matter of
 beer.

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Salomon.

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if it were in the state of arsenious acid, or an arsenite. I understand that such researches are in progress, but I do not know the results. It must evidently be a very prolonged and difficult investigation, and I should imagine that it would take some time before reliable data upon such a head would be forthcoming. I do not think they exist at the present moment in respect of beer or yeast.

1368. Are you able, from your knowledge, to trace the origin of those surmises? Have they been connected with the ascertained fact that certain forms of mucedo, aspergillus, and penicillium, to which you have alluded, have the power in contact with arsenical products of generating either hydrogen arsenide, or substances like diethyl arsine?—I believe that was the source of the suggestion. Indeed, it was mentioned to me by Dr. Reynolds. I believe it was an opinion, as you have mentioned, that such fungi would be found in breweries, and I pointed out to him the impossibility of finding them there in connection with beer.

1369. May we gather this from you, that it is your distinct opinion that no form of saccharomyces will give rise to these products?—I have no evidence whatever before me that such is the case, and as far as one is justified in speaking from present knowledge I do not think it is so.

1370. These things—penicillium, mucedo—are occasionally to be met with as spores or wild ferments in beer, are they not? I mean the various forms of mucedo and other things which have been mentioned?—Yes, they are occasionally to be met with, but in relatively negligible quantities when the beer is good.

1371. Are those ferments which are connected with the diseases of beer likely to form the compounds that the mucedo and the penicillium do?—They would come under another class. It would be more in the nature of butyric and lactic ferments; but I have no knowledge that those ferments which give rise to bad beer give rise to these compounds. There are various forms of sarcina, for instance, which give rise to very troubled and bad beer, the mycoderma aceti and various other ferments; but I have no knowledge that these have the power of forming the compounds to which you have made allusion.

1372. In the process of fermentation of beer is there any free oxygen in the liquid, conveyed originally from the air?—Yes; one has, in order to conduct a brewing fermentation successfully, to introduce air at certain stages of the fermentation, and that is best done by rousing the fermenting wort. Some introduce the air direct in the bottom of the fermenting vessel. The object of rousing and thus introducing the air is twofold. I am not sure that it is wholly intended to supply oxygen so much as it is to give a means of effectually disengaging the large proportion of the carbonic acid, and that carbonic acid being the excreted product of the fermentation; and the immediate environment of excreted products being inimical to the progressive development of any organism, it is desirable to remove them, and it is done, in the case of carbonic acid, by agitation resulting from the introduction of air; but as to whether or no the oxygen itself plays a part in invigorating the yeast is a question upon which I would not like to speak with dogmatism. In my opinion it does assist, but I would not like to go further than that.

1373. What I want to get from you is, do you think the amount of carbonic acid which is produced in the process of fermentation would eliminate or expel the oxygen from the air introduced. When you analyse the gases expelled from finished beer do they contain oxygen?—I could not answer that question offhand without reference. I do not think they do, but I am not sure.

1374. May I point out to you the significance of my question? If it is alleged that a poisonous substance like diethyl arsine or so-called cacodylic derivative is produced in the fermentative change, I think I need hardly point out to you as a chemist that the immediate effect of free oxygen associated with that would be to oxidise it to diethyl cacodylic acid?—That certainly would be so.

1375. And that substance, strange to say, is a relatively non-poisonous substance?—Yes, that has been proved, I think, by Gautier.

1376. It has been proved two or three times that it is only poisonous in very large amounts. These things require relatively large quantities to be injected sub-cutaneously or given as doses to produce any toxic action?—Now I think I can answer your question more satisfactorily, having understood it better. I think there can be no

doubt that such a change as you suggest must necessarily take place, because during the process of fermentation it is usual to move, at any rate in most of the modern systems, the beer from one vessel to another during the process; and not only by means of air introduced as I have explained, but in the process of dropping from one vessel to another, there is a large contact with oxygen, which would presumably act in the manner you have suggested.

1377. Supposing you are told that if you add known quantities of arsenious oxide to a wort and you then put the wort through the fermentative process, and you determine the amount of arsenic in the finished beer, and you found the exact equivalent to the arsenious oxide which you started with, would that in your opinion negative the supposition that any cacodylic compound had been formed?—It would. It must necessarily negative it.

1378. You say in your *procès* that in your opinion the best practical method of purifying Manchester beer from traces of arsenic has been to employ an increased quantity of brewing sugar, the purity of which was beyond suspicion. What is it you exactly mean by that?—I mean that when every brewing was tested, and it was discovered that malts and other materials contained hitherto unsuspected traces of arsenic, the Association, acted upon the advice of the expert committee, were so surprised that they would not pass any beer that contained even the trace as developed by this test. They found that the best way to dilute the trace was to bring it outside the limits of the test, strict as it was; so they added these brewing sugars, in which no trace of arsenic could be found. To my own knowledge, that plan was largely adopted.

1379. Yes; but that is not the specific action of the sugar. Any other material from which beer is made might be employed?—Quite so. It was a material which was known to be free from arsenic as against a material which was found in some cases to possess it in traces, and therefore the quantity of added sugar was augmented.

1380. It amounts to nothing more than this, that you go on brewing with pure materials, and by that means you eliminate arsenic?—Yes, absolutely.

1381. There is no specific action in the sugar?—No, I never meant to suggest that.

1382. You drew the attention of the Commission, in case any requirement should be made as to guaranteeing the purity of glucose, to the necessity of extending that guarantee to foreign glucose?—I did.

1383. You drew our attention to the necessity of having provisions made to cover imported glucose as well as home-made glucose or invert?—Yes, as a matter of protection to the public and justice to the brewing industry.

1384. Quite so. Do you apprehend that there will be any difficulty in securing that guarantee in the case of imported products?—I do not think there would be the slightest difficulty. I have examined all the foreign samples on the market and found them pure. I suggest that if there were to be an examination of all brewing sugars used, and that such examination were to extend to the examination of imported sugars, the guarantee would not suffice, but the sugars would have to be analysed at the port of entry or by the Customs, as, for instance, is done in the case of shipments of wines abroad to those countries where the use of salicylic acid is prohibited. I have frequently samples sent to me to examine for salicylic acid before the wine is sent abroad, because there are certain countries which will not permit such wines to enter if they contain salicylic acid. These examinations are made at the port of entry, and some such course would have to be adopted, provided all brewing sugars were examined and were required to be guaranteed as to purity.

1385. But would not the same arrangement suffice in the case of the imported glucose as in the case of the home-made glucose, namely, that the vendor should produce a satisfactory warranty or guarantee of purity as a condition of sale?—Personally, I believe it will be found quite sufficiently effective.

1386. Of course, there are large numbers of imported products of which are only sold by analysis?—Yes.

1387. The person vending them produces an analysis showing the character of the article which he offers for sale?—Yes.

Mr. A.
Salomon.
7 Mar. 1901.

Demand
arsenic
free brew
material

should be
tested at
port of
entry

and guar-
anteed.

A. G. 1388. And the articles are bought upon that analysis?
—Yes.

1901. 1389. The same system might be extended to the case of imported glucose?—Yes. I think it would be a sufficiently safe guarantee without being cumbersome—I mean without involving cumbersome machinery in order to ensure its purity.

1390. To your knowledge does the list of firms appended to Mr. Richard Garton's letter comprise all the makers of glucose or invert in Great Britain?—I believe it does. It was so stated to me.

origin 1391. Is much imported glucose used in breweries?—
starch. There is a considerable quantity to my knowledge. One particular brand, or I might say two particular brands are largely employed and held in high esteem, and deservedly so.

1392. Where do they come from?—One comes from America and is known by a particular brand name, and the other comes from Germany.

1393. Do you know the origin of those glucoses? What character of starch material are they respectively made from?—I believe the American glucose is wholly made from maize. I could not speak with certainty as to the starch that the German product is made from, but I know it is exceptionally pure as a finished article.

1394. Have you reason to know it is made from potato starch?—I know that potato starch is used in the factory from which the product comes, and the firm make very large quantities of liquid glucose and also potato farina. But I think also they employ other sources of starch. Therefore I am not in a position to state what is the origin of the German glucose. I do know that potatoes are very largely employed in the factory at which this glucose is made.

edge of 1395. You are aware of the statement, are you not,
in of Clouet and Ritter as to the presence of arsenic in
B. glucose?—Yes, I know those statements.

1396. Those were independent statements, were they not?—Clouet and Ritter's were independent.

1397. One is a French chemist, I believe, and the other a German?—Yes.

1398. Those statements had reference, had they not, to potato glucose?—Yes, I believe they did, because at the time those statements were made I do not think that other forms of glucose were known upon the market as commercial articles.

1399. Do you remember the date of the observations made by Clouet and Ritter?—I think I can give them to you. Clouet's publication is dated January, 1878.

1400. And Ritter's?—I do not see the date of Ritter's here. I think you give the date in your dictionary.

1401. No, I do not give the date in my dictionary, but the statement was taken from the abstracts of the Journal of the Chemical Society, in which references to the original papers were given. I believe that date was 1879?—Yes.

1402. I suppose that the fact of the possible contamination of glucose with arsenic was not generally known to English chemists?—Certainly not. We never expected it.

1403. In spite of the circumstance that the abstract in the Journal of the Chemical Society drew attention to the fact?—They drew attention to the fact, but on reference to the investigation of Clouet it will be found to deal with only minute traces.

1404. May I ask whether you have any business connection with any of these firms who make glucose and invert in this country?—I only analyse for them. I have no other connection with them whatever.

1405. Have you long analysed for them?—From time to time they sent me samples.

pg 1406. You yourself never thought it necessary to exam-
not ine those products for arsenic?—I beg your pardon. I
for should have said I am consulting chemist to one firm.
be. From time to time I periodically examine their materials.
I never thought it necessary to examine for arsenic. It
never occurred to me that it was possible it could be
there.

4576.

1407. Are you sufficiently acquainted with the procedure of these firms to know what character of oil or vitriol they would use?—I have made very serious inquiries. I have seen the guarantees in certain cases which they exacted from the manufacturers of the oil of vitriol, and I find that one may roughly say that either they insisted upon using an acid made from brimstone—in which case the possibility of dangerous arsenical contamination was out of the question—or they insisted upon an acid made from pyrites being purified so that it was free from lead, iron, nitrous compounds, and arsenic, and with such a guarantee the sulphuric acid made from pyrites would, as I have convinced myself, be quite as pure as one made from brimstone.

1408. (Chairman.) Was the guarantee you speak of exacted by the glucose manufacturers?—By the manufacturers of brewing sugars.

1409. Was it usual prior to the recent scare?—Yes.

1410. (Professor Thorpe.) How far back have your investigations extended with regard to that point, how much prior to this scare?—Generally I may say that my inquiries amongst manufacturers revealed the fact that they have always insisted upon those conditions being fulfilled.

1411. So they had been aware of the possibility of contamination of oil of vitriol with arsenic?—Fully aware of it.

1412. And taken steps to protect themselves?—Quite so, and taken very stringent steps. And it is only fair to add, that having examined the correspondence in this connection between Messrs. Bostock and Co. and Messrs. Nicholson, I do myself think, whatever may be the result of further investigation, that Messrs. Bostock and Co. were under the impression that they were always employing an acid made from brimstone, and hence that they were sufficiently protected.

1413. But you have informed the Commission that to your knowledge manufacturers have not invariably preferred to use brimstone acid?—No; they do not; it is a mere question of choice, given equal purity. Brimstone acid and its liability to contain arsenic.

1414. Would a manufacturer who used brimstone acid think it unnecessary to test his oil of vitriol?—I should say certainly. He might as a precautionary measure test it from time to time, and probably it would be the right thing to do. I have reason to believe that tests were made by manufacturers, even in the case of brimstone acid.

1415. Is it not within your knowledge that native sulphur not infrequently contains arsenic?—It does, but in minute traces. There was one kind of sulphur which used to come to a considerable extent upon the English market, namely Spanish sulphur. That sulphur is no longer upon the English market.

1416. But it might be?—I do not think there is any possibility of its coming again, but I quite agree that tests should be made as to the purity even of brimstone acid. Then some of the Japanese sulphur does contain arsenic. I happen to be very largely associated with the sulphur industry, and I know that Sicilian brimstone is free, to within a minute trace, of arsenic, and that arsenic is scarcely ever found in it. Then there is the sulphuric acid that may be produced from spent oxide.

1417. You do not know, or do you, that occasionally pockets of arsenious oxide are to be found in deposits of native sulphur in Sicily?—I have heard it said so, but I have had many samples through my hands, and I have tested a good deal of Sicilian sulphur of late for arsenic, but I have not found it. Still, I do admit the possibility of such pockets existing, and I agree with the suggestion that even if brimstone acid be employed, frequent tests should be made as to its freedom from arsenic.

1418. You yourself would not say it is a sufficient guarantee in any demand for sulphuric acid that it should be made from brimstone?—I would not; but I would say one would be reasonably safe in using it. An unforeseen accident might occur and therefore testing would be much safer.

1419. Quite so; and in view of what we now know, you say that testing should be obligatory?—I do most undoubtedly. All acid used by sugar manufacturers should be tested.

1420. I suppose it is a fact that by far the greatest proportion of sulphuric acid made in this country is made from pyrites?—By far the larger proportion.

1421. More than nine-tenths?—I should think it would be quite fair to say that.

Mr. A. G. Solomon.

7 Mar. 1901.

Pure acid used in sugar factories other than Bostock's.

Brimstone acid and its liability to contain arsenic.

All acid used by sugar manufacturers should be tested.

Mr. A. G. Salomon.

7 Mar. 1901.

Brimstone acid.

No objection to use of de-arsenicated pyrites acid.

1422. And therefore that fact alone would tend to the use of pyrites-made acid in manufactures generally?—In manufactures other than food stuffs or pharmaceutical preparations I should say that pyrites acid would be almost invariably employed.

1423. But in spite of the fact that even among pharmacists it is known that brimstone acid not infrequently contains arsenic, the pharmacist would not rely upon the mere origin of the sulphuric acid in forming an opinion as to its purity?—No, he would not; he certainly should not.

1424. Have you seen a paper by the late Professor Bloxam upon the occurrence of arsenic in sulphuric acid?—I have seen an abstract of it, I think.

1425. You will perhaps have seen the original paper in the Journal of the Chemical Society some forty years ago, in which Professor Bloxam showed that practically every sample of sulphuric acid made from Sicilian brimstone contained arsenic. Are you aware of that paper?—I have a faint recollection of it; I will look it up.

1426. I presume there is no particular difficulty in getting pyrites-acid freed from arsenic?—I have made inquiries among the manufacturers, and I have closely questioned them, and, knowing the methods that are a rule are adopted, I think there is no difficulty whatever, and the increased cost of such pure acid is very small.

1427. Therefore, what you tell us comes to this: That you see no necessity to restrict the manufacturer to the use of brimstone acid, but you do think it necessary to call upon him to ascertain the purity of the article which he uses, by chemical tests?—If you can effectually guard the purity of the acid delivered into the works for the purpose of manufacturing food stuffs, I say it is possible to make an acid from pyrites which shall be quite as pure as acid made from brimstone, and that in either case a freedom from arsenic can be secured upon a commercial scale.

1428. (Chairman.) In the case of sulphuric acid made from pyrites, can the arsenic be removed during the process of manufacture, or is it necessary to adopt a special purifying process?—It is purified by a separate process.

1429. After the manufacture of the acid?—Yes; after a certain stage of the manufacture.

1430. In the English process of making sulphuric acid from pyrites, arsenic will get into the acid, I suppose?—Yes.

1431. That is if there is arsenic in the pyrites?—Yes.

1432. We have been told that in the German method the shape of the flues and the dimensions of the apparatus are different from those in the English process, and that a large part of the arsenic by that means does not get into the acid at all. Have you experience of that?—I know the difficulty that a very noted German firm experienced in dealing with sulphuric acid in connection with a recent invention, and their difficulty consisted in freeing their sulphuric acid from arsenic. Beyond that I could not go.

1433. They did not claim that they could produce it from pyrites direct without arsenic being in it?—I know their attention was directed to the elimination of arsenic from the sulphuric acid, presumably manufactured by them in Germany, and therefore I should doubt such a statement. But beyond that I could not go; it would be a matter which would require to be investigated.

1434. (Professor Thorpe.) Have you much personal knowledge of the manufacture of oil of vitriol?—No, I do not speak as a manufacturer, but I have made inquiries and studied it since this investigation. Otherwise I could not speak as an expert in the manufacture.

1435. Is it within your knowledge that the manufacturers of invert and glucose sugar are now giving warranties of the purity of their articles from the manufacturer?—Yes, they are.

1436. Have they done that voluntarily or has it been demanded from the brewers?—I should think it would be a little of both, but I could not say.

1437. There is no difficulty about the matter, then?—No, I should say that brewers would not now buy brewing sugar which was not guaranteed by the makers. The makers would be quite willing to guarantee it. Except in the unfortunate instance of Messrs. Bostock they

are only guaranteeing to deliver what they have previously done.

1438. You have no knowledge of the particular tests which are employed by the makers of glucose in connection with their guarantees? Have you any knowledge of the tests they use?—The precise tests themselves?

1439. Yes?—No, I have not.

1440. Then, of course, those guarantees may possibly have relation to very different tests?—I am speaking as to guarantees of freedom from arsenic.

1441. Yes, but I ask you whether those guarantees may not have relation to very different tests?—I consider it improbable.

1442. Do you mean that they are all tested by an uniform method?—I should imagine they were all tested by the Marsh method. I could not say as to how the solution would be prepared, or as to whether they would all adopt a uniform method. I do consider, if I may say so, that it is very desirable the Commission should approve of a method which all makers could adopt, and which if carried out would protect the public.

1443. The object of my question was this: Of course, the tests possibly might be of unequal stringency?—I quite agree.

1444. And your recommendation is that they should be of sufficient and uniform stringency?—I agree.

1445. There would be no difficulty on the part of the glucose manufacturers in conforming to this?—I see none whatever; they all have laboratories and chemists.

1446. Have you considered what precise form the guarantee might take?—I have; but I would ask, with respect, that I may defer my answer to that, because some other questions, notably those connected with the possible presence of selenium, must of necessity be involved in my reply to your question, and one would like to hear a little as to what is alleged with respect to selenium, and then subject the statements which are made to further investigation before replying to that question.

1447. Quite so; but the object of my question was not exactly to bring out the specific and precise details of the form; it was rather upon what general principle the guarantee should be constructed. I suppose you would agree with me that a mere general warranty or general guarantee is not sufficient in respect of arsenic or with respect to a product turned out by a manufacturer; that is, giving a guarantee dated, we will say, the 1st of January, that would be supposed to cover a whole year? That is what was in my mind?—Certainly not.

1448. You would require a specific guarantee attaching to every delivery of the article?—Certainly, I think it is necessary. I would also point out that I have frequently been asked to give certificates "for freedom from arsenic and other deleterious ingredients," but I have always refused to give such a guarantee, because that would mean an analysis for every conceivable thing which would be deleterious. That, of course, would be impossible.

1449. Your guarantee is intended to relate to particular ingredients in a particular sample?—Exactly, and I think that should be enforced upon the manufacturers of these substances which are destined for food consumption. It might want consideration as to how such a guarantee should be drawn up, but on broad lines I would make that suggestion.

1450. Does this form of guarantee commend itself to you in principle, that the guarantee should state that the sample of invert or glucose designated by particular marks, and referred to in certain invoices, has been tested in accordance with the prescribed method, and has been found to contain no indication of arsenic?—It occurs to me that that would be an excellent guarantee, assuming the prescribed test to be a stringent one such as you suggest.

1451. You agree that it should be prescribed by some central authority?—Quite.

1452. That guarantee to be signed by the analyst who actually made the chemical test, and countersigned by some responsible person, either the manager or a proper person designated by the manufacturers as evidence that the responsibility for the testing having been done is shared by the manager, or director, as the case may be?—Yes, I think it is highly necessary that the proprietors of the works should certainly take upon themselves the responsibility, because they have

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but may have value.

Guarantee should specify relate to arsenic test.

Manufacturers be responsible for

1901. the selection of the chemist, and it is for them to see that they originally employ a competent man, and that he is kept up to the mark in his work, and, therefore, I should certainly think the manufacturer ought to take the responsibility.

1453. That is to say the signatories should be jointly and severally responsible for the character of the certificate?—Personally, I think the responsibility should rest upon the purveyor of the material.

1454. I am only talking of the validity of the certificate for the moment?—It would certainly require the signature of the chemist who made the analysis.

1455. At the present time the certificates you have seen are not exactly in that form?—No, they are not.

1456. In many cases it is a mere general statement of purity, is it?—Yes, a general statement of purity.

1457. That you think is not sufficient?—Having regard to the existing circumstances I do not think it is.

1458. Have you looked for selenium in any materials that have come to you?—Yes, I have. But I am not in a position yet to speak upon the question.

1459. I do not want to press you upon this point if you prefer not to be pressed, but have you made experiments, or have your experiments gone sufficiently far, to say that there is, at all events, any very large quantity of selenium in these products?—I have not attempted a quantitative determination of traces of selenium, and as far as I have gone I have only been able to determine the presence of minute traces in certain substances, but I would not like to say, even to-day, that it is selenium. I have really not gone sufficiently far to speak with any certainty upon the subject, and I would wish to reserve my remarks upon that.

1460. Can you tell the Commission at this stage whether the amount of selenium which you recognise is commensurate with the amount of arsenic that has been found?—Certainly it would not be at all commensurate. I have not found selenium in beer up to the present.

1461. Do you know sufficient of this to be able to tell the Commission what are the relative prices of the various forms of brown oil of vitriol which are commercially saleable; what is crude brown oil of vitriol, say, for instance, of the relative strength of 80 per cent., or any other percentage you like?—I have not those data with me. If my memory serves me aright, Messrs. Bostock and Co. were paying 52s. 6d. a ton, but I would not like to be quite sure of the figures.

1462. Is brimstone acid very much dearer than the other acid?—No, it costs about 2s. 6d. to 3s. more a ton to make.

1463. Is brimstone acid dearer than de-arsenicated oil of vitriol?—The de-arsenicated oil of vitriol made from brimstone would be about 2s. 6d. to 3s. per ton dearer, and the brimstone-made acid would, I suppose, be about 5s. a ton dearer than the crude, what is called B.O.V., brown oil of vitriol.

1464. Then the brimstone acid is the dearest form of the three?—Yes, I think it would be.

1465. Therefore that of itself would incline manufacturers to take the de-arsenicated pyrites acid?—Yes, it would. There is, however, not very much difference in the price when regard is had to the quantities in which the acid is employed in the production of the brewing sugar.

1466. (Mr. Cosmo Benson.) How many hundredweights of brewing sugar to the ton of acid is produced?—The proportion of acid employed will vary very much. In respect of invert sugar 3 per cent. by weight upon cane sugar would be a fair average maximum. But there is no hard and fast line to be drawn. It depends upon the composition of the sugar to be employed. If the manufacturer employs sugar containing a large proportion of ash by using syrups from which crystals have been extracted, and the ash accumulated in the syrup he would have to employ more acid than he would if he were using crystallised sugar, and therefore it is very difficult to give a fair average. But I think that my figure of 3 per cent. as a maximum would be fair. Then in regard to the production of glucose from starch considerably more would be employed, and that would amount to about 6 per cent. as against 3 per cent., in other words about double. That, again, would be sub-

ject to variation dependent upon the steam pressure under which the conversion was made.

1467. (Chairman.) What steam pressures are generally used?—Normally 40 to 50 lbs. per square inch.

1468. The object, I suppose, is merely to raise the temperature?—Quite.

1469. (Professor Thorpe.) I have not yet asked you any questions respecting the methods employed, or respecting the quantitative determinations, because I understand that you wish to defer your evidence upon those points?—I would prefer as regards the quantitative determinations to defer them, because it was arranged by Mr. Fletcher Moulton, as directing our committee, that we should attempt to devise a system for the quantitative determination of arsenic in beer and brewing sugars, just as we did a method for its qualitative determination in beers, which would safeguard the public, and we have had so much to do in the investigation with regard to the traces of arsenic that we have not yet been able to meet to devise a process of making quantitative determinations together. Therefore, I would wish, with respect, to defer my evidence upon that point until such time as we have settled the method.

1470. Are you in this respect acting independently of a committee of chemists who are engaged on the same problem of quantitative determination?—Yes, certainly.

1471. You are aware that the Society of Chemical Industry is taking some action in this matter?—I have heard of it quite recently.

1472. Do you associate yourself with that committee in any way?—No. We should be very happy to, probably, but we have not yet associated ourselves with them.

1473. I understand the object of that committee is to bring evidence before this Commission of the varied methods and methods sufficiently stringent which may be employed. Is that so, or is it not?—I believe it is an extremely good idea, because it is very desirable that the manufacturers should be able to speak upon the point, they having to carry out any test which might be devised or recommended.

1474. (Chairman.) With regard to the question of malt as containing arsenic, can you state what is the greatest amount of arsenic contained in samples of malt, and how much that would introduce into a gallon of beer?—The determinations of traces of arsenic in malt are more in the nature of estimations than of accurate determinations. I do not apply these remarks to the determination of arsenic in contaminated beer, because there would be no question as to the public being properly protected by the methods of analysis now practised. But in respect of the analysis for traces of arsenic in malt it would be difficult in my opinion to do more than make a comparative estimation of such traces, and in so doing one would have to take large quantities of material, say, 50 grammes, for an analysis. I might perhaps illustrate it by showing you what I showed yesterday to the Commission from another point of view. (A set of arsenic mirrors was exhibited.) In the tube with the mirror is the quantity resulting from the 50 grammes of malt, and fairly represents the trace that would be obtained in malt.

1475. Is that what you would consider a large quantity?—No, I consider that a trace.

1476. This is metallic arsenic, is it?—Yes, this is 100th part of Bostock's sugar. That is half a gramme of Bostock's sugar and this is 50 grammes of the malt. Now, in order to compare those two in regard to quantitative determination of the arsenic, that would merely be done by a comparison of the relative appearance of the two mirrors, and, therefore, I suggest that that cannot possibly be other than an estimation. That makes it somewhat difficult to say how much arsenic is really in malt, and how much thereby would be introduced into beer. But there can be no doubt that the quantities thus introduced are mere traces, and fall into a totally different category from those in which Bostock's sugar was employed.

1477. Has the malt dust been tested quantitatively for arsenic?—I mean the dust proceeding from the brushing and screening of the malt?—I have not tested that quantitatively, but it would not be a difficult thing to do so, because the proportion of dust to malt would be so

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Brewers' Expert Committee are continuing their inquiry into tests for arsenic.

Society of Chemical Industry also investigating tests for arsenic.

Arsenic in malt.

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small—that is to say, there is so little dust to such a great mass of malt that if one did collect the dust of the malt which contained a minute trace of arsenic, one would expect to find that dust containing arsenic in considerable quantity, and that, I think, would be certainly capable of accurate determination.

1478. Is it not desirable that such a determination should be made?—Yes, and it shall be done.

No necessity for malt to contain any arsenic.

1479. I mention that because there is some apprehension just now as to positive danger from malt which had been made with fuel which was not free from arsenic in malt kilns?—I shall be able to present at a later stage full details respecting that, and the result of hundreds of analyses that my colleagues and I have been making in connection with the subject. But generally I may be permitted perhaps now to say that the bulk of the malt as sold in this country is free from arsenic, even from minute traces. There is no necessity that any should contain even minute traces, and it merely requires a recommendation, followed by some means of ensuring it being carried out to eliminate one form of fuel used in the malting. Then I think it may be stated with certainty that malt can be produced free from traces of arsenic, even the traces which have been discovered.

Gas coke should be avoided in malting.

1480. Do you consider that the brushing and screening as at present practised on malt, which has acquired some arsenic in the kiln, is sufficient to take the arsenic away and to prevent danger?—From what the medical authorities tell me the arsenic due to malt does not at the present moment constitute a source of danger, but it is quite conceivable that it might, and having made this discovery I do think that the maltsters should use a sort of fuel which would not subject the public to any possibility of danger, and that, as far as our investigation goes at present, is easily to be obtained by not using gas coke.

1481. It would be considerably more expensive, however, I suppose, to use anthracite or other proper fuel?—I do not think so, because coke is only part of the fuel used. I am not aware of malting being conducted where they use wholly coke. It is used to produce a fierce heat at the final stages of malting, and frequently it is mixed with anthracite for that purpose. I do not think it would materially add to the expense of the malting. If the maltster were to employ anthracite and not hurry his malting, but carry it out in a proper manner, it would make a better article. I know that in all well regulated breweries they insist that the malting shall be kilned with anthracite.

Products of combustion pass through malt.

1482. Have you any experience of malting in Scotland with regard to the peat reek flavour in whisky derived from fuel?—It is necessary as regards the flavour of malt for brewing that it should have what the brewers know as a certain amount of "fire" in it, but whether that fiery flavour be due to the empyreumatic fumes or not it would be difficult to say, but I think that is a necessity. We shall, however, be able to convince you that it can be obtained without the slightest risk of arsenical contamination provided that gas coke be not employed.

1483. Do you not think that a red-hot plate under the malt bed with proper arrangements for carrying atmospheric air through the malt would not give the same results as to the fire, and yet keep the malt absolutely away from the fumes of the burning?—I have no doubt that such an arrangement could be carried out, but I would venture to call your attention to the fact that any radical change of that character would involve the outlay of huge capital.

Alteration in system of kilning would mean great expense.

1484. It would mean enormous expenditure?—Yes, enormous expenditure. It could then only be slowly carried out. There is no question that there is room for improvement in the construction of our English malt kilns, and many of our brewers are very much alive to that fact, but to remodel the whole system of kilning would be an extremely important and large undertaking, and certainly would necessitate a great deal of time.

1485. At present you think thorough security may be had by the use of anthracite?—I think so undoubtedly. I hope I shall be able at a later stage to present the result of our experience in that connection, and then your Lordship will be able to judge for yourself.

1486. (Professor Thorpe.) Do you think that the line of least resistance, namely, that which is most quickly attainable, will be followed, namely, to look to the fuel?—I do.

1487. And if the fuel is adequately looked to there is no necessity, you think, to reconstruct the arrangements in the malt kilns?—That is my opinion.

1488. (Mr. Cosmo Bonsor.) The maltster could give the same class of guarantee as the glucose manufacturer?—Clearly.

1489. That would be a protection to the public?—That would be adequate, I think.

1490. (Sir William Hart-Dyke.) You say, speaking from your knowledge, that the only possibility of contamination of malt by arsenic is through the use of a fuel from the fumes of which this result is brought about?—That is my impression.

1491. And also, supposing the Legislature or a Department were to visit with penal consequences the use of fuel which was dangerous as regards the malting processes, that that would produce absolute security to the consumer of beer?—I am not in a position to express an opinion as to penal consequences, but—

1492. Well, we will put that on one side for a moment, and say provided the security were maintained for the future with regard to the use of fuel?—I agree.

1493. (Chairman.) You have spoken of hops as sometimes, though rarely, containing minute traces of arsenic. I think that was in your evidence?—I do not think I actually gave evidence upon it, but I can say that I have found minute traces in hops, and that would be due to the same reason, and possibly due to traces contained in the sulphur. I think that there would be no difficulty in securing absolute freedom even from these traces in respect of hops. I see no more difficulty for the hop-maker than I do for the maltster.

Traces arsenic hops.

1494. Sulphur is used for colouring the hop leaves, I believe?—It is used, I think, for the purposes of preventing mildew—that is on the pole.

1495. I have heard it said that sulphur fumes have the effect of colouring the hop leaves in a manner which was considered suitable for some particular beer, or some particular qualities?—I could not speak as to that, but I know that the hop grower pays a very considerable price for his sulphur which he does so employ, and he would have no difficulty in getting a guarantee as to the freedom of that sulphur from arsenic; and in respect of his fuel he would certainly be able to take the same precautions as you have suggested in respect of the maltster.

1496. (Dr. Whitelegge.) Was this danger of the introduction of arsenic by malt and hops known to maltsters and brewers before the present epidemic, say, a year ago?—Only as far as the quotations that have been referred to by Professor Thorpe are concerned.

Liability malt to tain arsenic unknown fore epidemic

1497. But that was in connection with glucose?—Yes.

1498. I was intending to leave that, and was referring only to malt and hops.—I have never heard of it before this epidemic, and I do not believe it was known. It might, of course, have been reasoned back; it is a question one could have reasoned out, but, as a matter of actual fact, I do not believe the presence of traces of arsenic in malt or hops was ever suspected until this outbreak.

1499. Was it the practice of any brewers to require assurance with each consignment of malt that the drying had been effected by anthracite?—I could not say that.

1500. You are not aware it was the practice of any brewers?—No, but I know it is the practice of brewers to carefully inspect their malt, and from that point of view they would take note of the classes of fuel that was used, and they may have used—I think they have used—this gas coke in ignorance of its possible effects; that is to say, the possibility of introducing small traces of arsenic into malt.

1501. You think that in future some sort of certificate as to which you have discussed with Professor Thorpe in the case of glucose would be right in the case of hops and malt?—Yes, I see no reason why it should not be given, because there would be no difficulty in acting up to that.

1502. If the brewer has guarded himself by a certificate as regards the materials he uses, what assurance do you think it would be proper for him to give to his hardy customers? Would you think a warranty from the brewer was desirable?—Well, warranties always complicate business.

Guarantee by brewer to his customers? Would you think a warranty from the brewer was desirable?

1503. Would you suggest that the consumer should rely upon the precautions which the brewer has taken with regard to materials, and not require any direct assurance from the brewer?—I do not know whether the brewer should be called upon to give a direct assur-

ance, but I feel confident if the suggestions which have been discussed were given effect to, that no other warranty would be necessary, and that the public would be adequately protected. It seems to me that to call for a warranty from all these different purveyors of material, and then to bulk them into a warranty to be handed to the consumer, is complicating the question, from a commercial standpoint, rather too much.

1504. Do you suggest that the brewer should rely upon his warranty, or should himself, through his chemist, examine all the materials supplied to him?—I think he undoubtedly would examine them through his chemist. Brewers in the past have been in the habit of examining their materials for suitability as regards manufacture. They would certainly have examined them for arsenic had they had any suspicion of its possible presence. But now they will assuredly test for themselves, in addition to any guarantees that may be given by the makers.

1505. You think that will continue in future years?—I feel sure of it.

1506. I do not think that it appeared in your evidence, but in the summary you gave us you spoke of a special difficulty in determining the arsenic in sugar. And there is also another point. You speak of the extreme solubility of the arsenic.—With regard to the difficulty of determining arsenic in sugar, that is a misprint on the *precis* of my evidence; it should be in beer, not sugar. I should have alluded to that in my evidence to-day. It must not be thought that I mean by that beers which are the subject of summonses for contaminated beer—I am speaking of the traces.

1507. What is the extremely soluble form in which arsenic is present in brewing sugar?—It is arsenious acid, or an arsenite which I had in my mind when I made that statement.

1508. If I followed you rightly in your answers to Dr. Thorpe, you do not think that there is any probability of the arsenic in any of the ingredients, or in the beer itself, being present in an organic compound?—I do not; not in the form that has been suggested, certainly.

1509. Not in that particular form; but, of course, there may be other forms?—I thoroughly endorse the suggestion of Professor Thorpe, if I may be allowed to do so, that if the compound that has been alluded to were originally present, it would certainly be converted, by the action taking place during fermentation, into the most harmless form of arsenic which is known.

1510. But there may be other organic compounds; could you say that the presence of oxygen would render all of them similarly innocuous, assuming them to exist?—I could not make such a statement without studying specifically each suggested combination.

1511. You think it is not probable, but you have no information directly showing the impossibility of the formation of organic compounds?—No; but it appears to me at the moment to be a piece of academic theorising. The suggestion that it is in that form I do not think is supported by evidence.

1512. Assuming the arsenic to enter into organic combination of any kind, would the tests which you are in the habit of employing reveal that arsenic?—I think so; as far as one knows, it would.

1513. I thought you told Dr. Thorpe that if such a combination were formed the arsenic would not be found on analysis in the same quantity as that in which it was introduced?—As arsenious acid, as Professor Thorpe put it to me.

1514. (Professor Thorpe.) The question I put was this: If you had introduced a known weight of arsenious oxide into a wort and you then fermented the wort, and after the beer was finished you, by your analytical processes, got back the same amount of arsenious oxide, you would infer that no formation of such an organic compound as diethyl cacodylic acid, or any analogous compound, had been produced?—Quite so. That is, that the arsenious compound had remained intact and unaltered, none of the arsenious body had been removed. If you start with a certain quantity of arsenious compound and you end with it, it is quite obvious that nothing has been converted.

1515. (Dr. Whitelegge.) It may be clear to you and to Professor Thorpe, but I am not speaking as a chemist. If you introduce arsenious oxide in the early stage, and you recover arsenious oxide by some process of

analysis when the beer is complete, does it follow that it has been arsenious oxide all through; or may not your process of analysis represent it as arsenious oxide, although it may have been in an organic combination?—There is a possibility of that, yes. It would be a remote possibility.

1516. So finding arsenious oxide would not in itself disprove organic combination?—It is difficult to answer that question, because the suggestion may be quite accurate; but the true answer could only be given after experimenting with definite compounds in such a case. I would not like to make a statement of a broad, general character in respect to compounds which one has not dealt with by way of test.

1517. (Professor Thorpe.) What Dr. Whitelegge means, I think, is this. That you might start with arsenious oxide, it might give rise to a product distinct from arsenious oxide, but the analytical treatment which you put it through would eventually get it precipitated as arsenic sulphide, and in an amount equivalent to the arsenious oxide with which you started?—Yes, that it quite conceivable.

1518. But my point, directed to diethyl cacodylic acid alone, was that that would not occur in that particular case. The arsenic which is in the diethyl cacodylic acid is not precipitable by sulphuretted hydrogen in the form of arsenious sulphide; in that respect the arsenic is exactly in the same relation that cyanogen is in the ferro-cyanide of potassium. Cyanide of potassium is a very poisonous substance, but you can convert it into ferro-cyanide, which is a perfectly innocuous substance?—Yes.

1519. (Dr. Whitelegge.) What I had in my mind did not refer especially to cacodylic acid?—I suggest that one would need to have definite specimens upon which experiments would have to be made before any statement would be justifiable in respect to their behaviour.

1520. If arsenic were present in organic combination, with cacodylic acid or otherwise, would it give the Reinsch or Marsh test as ordinarily employed?—With respect to cacodyl, I believe there would be a difficulty, but I have not made those experiments, and I therefore would not like to say.

1521. You made a number of analyses of beers and the brewing materials used by Lancashire and London firms?—I have had them from firms all over the country. Arsenic in non-Bostock beer only as traces.

1522. And outside what one may call the epidemic area you have not found arsenic present?—Except in the two cases to which I referred, where I found that Bostock's sugar had been employed, and then by acting promptly the beer was destroyed, and I believe no trouble resulted. But besides I have found traces of arsenic, I will not say negligible traces, due to malt and other substances, but certainly not what one could regard as poisonous or dangerous quantities.

1523. You are satisfied that no practical mischief could have happened with such beers?—As far as I am informed by the medical authorities as to the quantities that would be injurious I feel quite sure upon that point.

1524. I do not think you have given us any evidence as to the test which was formulated by the Expert Committee?—The test is as follows:—"Take 200 cc. of the beer in a porcelain evaporating dish. Raise the liquid to the boiling point and then add 30 cc. of pure concentrated hydrochloric acid. Insert a piece of pure bright copper foil, about a quarter of an inch by half an inch in size, and keep the solution gently boiling for 45 minutes. If at the end of that time the copper remains bright and red, the beer is free from arsenic. If a deposit is obtained on the copper the foil is to be washed successively with water, alcohol, and ether (care being taken that these are pure), dried at a temperature not exceeding 100° C. and subjected to slow sublimation in a thin reduction tube of small section, and not less than 2 inches long, the upper portion of which should be warmed before the sublimation begins. For the purpose of the sublimation a small spirit lamp flame should be used. If any sublimate is obtained, it must be examined under a magnifying power of about 20^x diameters. Any sublimate which does not show well-defined octahedral or tetrahedral crystals is not to be considered arsenical. N.B.—It must be borne in mind that the blackening of the copper or a deposit thereon from the preliminary operation does not demonstrate the presence of arsenic in beer. Abundant blackening and deposit may be obtained from the purest beer.

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Mr. J. G. Salomon. 1525. In what light do you regard that test? Am I right in supposing that it is a provisional test meant to meet an emergency, and meant to eliminate what the Committee regarded as the dangerous varieties of beer?—Precisely. It was not a test which was meant to deal with minute traces, it was a test conceived after consultation with Professor Delepine, Sir Lauder Brunton, Dr. Stevenson, and Dr. Luff, as to a means of preventing beer being sent out to the public, at a moment of crisis, which contained poisonous quantities of arsenic; and by blank tests, which were made by several of us, we proved that that would protect the public by not permitting a beer to pass that had more than one part of arsenious acid in $1\frac{1}{2}$ million parts by weight.

1526. It would protect the public to that extent?—Yes, and we have since found that it is far more sensitive than we thought.

1527. So that the delicacy which at first you found amounted to one-twentieth of a grain per gallon you have since discovered to amount usually to about one-fortieth?—About that, yes.

1528. This test is put forward by the Committee, not as a final standard of what is right or wrong in the matter of beer?—No, not at all; but simply as a provisional test intended to cope with the special difficulty.

1529. May we assume that if arsenic as introduced into glucose by reason of the sulphuric acid being contaminated, that in one day's make with the same acid we should expect to find arsenic pretty uniformly diffused through that glucose?—I should expect a variation.

1530. A material variation?—Yes, I think I may say I should expect a material variation.

1531. Is it a fact that at every Manchester brewery at the present time all beer is examined for arsenic before going out?—I believe it is certainly done even to-day. But Mr. Groves will be able to speak as to that. That is my information, that the testing is still kept up.

1532. Is that practised elsewhere than in the Lancashire districts to your knowledge?—I could not speak as to that, I am receiving many samples of beer to test with regard to purity and freedom from arsenic, and I assume others are doing the same, and that all brewers are on the alert for arsenic. In fact that I know.

1533. You told us about the examination of the casks, and said you satisfied yourself that the casks had been thoroughly purified from any traces of arsenic. Were those casks specially treated in any way, enamelled, for instance?—Some of them that I tested were enamelled with a preparation known as Crawford's enamel, and I scraped the enamel and found that free. But other casks which I took in other breweries were not enamelled. It is not a uniform practice to enamel casks, and I found the wooden scrapings in other cases were quite free from arsenic. No source of danger remains there, I feel confident.

1534. And the methods of cleansing adopted in the brewery you referred to were adopted in breweries generally?—Yes, the cleansing of casks is necessarily efficient in breweries if the beer is to remain in good condition, and I feel sure after my experiments in that direction that there is no danger in respect of the cask

plant. All other plant is periodically cleaned, and also every day after use.

1535. (Professor Thorpe.) There is one question further. The sulphur which may be in hops may be introduced in two ways, it may be dusted over as you state to prevent mildew when on the poles, or small quantities of sulphur may be on them in the kilning?—Yes.

1536. Suppose you introduce hops containing this adherent sulphur into a wort which contained dissolved arsenious oxide, and the whole boiled together, would that not tend to the formation of sulphide of arsenic?—I should think it would.

1537. You know when you boil flowers of sulphur with water small quantities of sulphuretted hydrogen are formed?—Yes.

1538. The arsenic sulphide would be the so-called colloidal stage; and when boiled would be precipitated?—Yes.

1539. And the yeast would tend to collect it?—Yes.

1540. That may be the origin of a quantity of arsenic precipitated on the yeast?—Yes, possibly I think it is worth following up the suggestion, although the amount of sulphur I have found is very small.

1541. It is as sulphide formed by the action of sulphur on arsenious oxide obtained from the glucose?—That may be worth following up, and I think it is an extremely valuable suggestion. It may account for the way the sulphur gets into the yeast.

1542. What strikes one is the extraordinarily fortuitous method in which the yeast seems to pick up arsenic?—Yes.

1543. May not that be explicable on account of hops being sometimes treated with sulphur and sometimes not, and so depend on the relative amount of sulphur which might be on the hops?—Yes.

1544. (Sir William Hart-Dyke.) Are you aware that the sulphur put upon hops is applied to the hops on the poles as the cleansing process?—That is what Professor Thorpe refers to.

1545. But there are two processes; in one, the sulphur is applied to the hops in growth, whereas this is done during a dusting process?—I have seen it done.

1546. Is it not the fact that hops after this dusting process are subject to rain storms, and there is this constant cleansing going on?—Professor Thorpe is only referring to minute quantities; it is not large quantities. There is the possibility that any which has been washed away in the manner you suggest may act in the manner suggested by Professor Thorpe.

1547. Surely it suggests itself to you as a practical man that this being applied to a plant which is in growth, especially in a climate such as ours, with the wind and the weather, it is scarcely possible for any appreciable quantity to remain on?—We are not dealing with appreciable quantities. Following the suggestion of Professor Thorpe, we are only dealing with traces. The hypothesis is concerned with the possibility of the minutest quantities.

1548. (Professor Thorpe.) I might, perhaps, remind my colleagues that sulphur is extremely difficult to remove, even when it is wetted. If you dust it on to the plant, you may afterwards wet it as much as you like, but you will not succeed in getting it all away?—That is so.

Mr. JAMES GRIMBLE GROVES, M.P., called; and Examined.

Mr. J. G. Groves, M.P. 1549. (Chairman.) I believe you are connected with a firm of brewers in Manchester?—I am Chairman and Managing Director of Messrs. Groves and Whitnall, Limited, carrying on business at Regent Road Brewery, Salford, and Alexandra Brewery, Holme, Manchester. The business of the latter brewery we purchased last year from the executors of the late James Cronshaw. The scope of our business is principally confined to Salford and Manchester, and our output is considerably the largest in those two towns.

1550. When did you first become acquainted with the fact that suspicions were directed towards the purity of beer in the neighbourhood of Manchester?—Until the month of November last year I had no reason whatever to doubt the purity of the beer that my company was supplying. We have a large number of tied houses,

and the beer supplied by us to these houses is identically the same as the beer supplied to free houses—there is absolutely no difference in quality.

1551. I understand you wish to give us a chronological account of the action taken by your brewery with reference to the discovery of arsenic in beer in your district?—On November 12th Dr. Cran, one of the district medical officers of Salford, called on me with reference to the amount of sickness in his district. He said that as one of the district medical officers his attention had been called to the increasing number of cases of alcoholic neuritis, as he then described it. "The sickness was alarming, and there were many deaths traceable to it." He came to me because he was in the particular district of Salford in which our brewery is situated, and I had an added interest from the fact that I represent that par-

G. ticular division in Parliament. He considered that the
A.P. 1. disease was principally localised amongst the drinkers
of beer, and his theory was that it was due to some of
901. the forms of the higher alcohols which may be referred
to as fusel oil. I suggested that this was rather more
indicative of spirit drinking than beer drinking, but he
replied that the evidence very strongly pointed to beer
drinkers, and not spirit drinkers, although it might be
assisted by the consumption of spirits. On November
15th I gave instructions for samples to be taken of the
principal beers sold in the district, including our own,
for the purpose of testing the soundness of the theory
advanced. 24 samples were taken, that is, 12 in dupli-
cate. On November 16th I forwarded the samples,
marked A to L, to Mr. Gordon Salamon, of London, for
investigation, informing him of the theory raised. I
believe the analysis for higher alcohols is a tedious and
difficult process. In the afternoon of this day, Dr.
Tattersall, Medical Officer of Health for Salford, called
on me with reference to the same subject, he having
previously seen Dr. Cran. He expressed the same
views, and held the same theory as to the cause of the
sickness. I told him he was free to examine our
brewery, and take samples of anything he liked, includ-
ing our beers and all the materials used in connection
with our business. I offered to assist in every possible
way to get at the bottom of the mystery. Shortly after-
wards he obtained from us various samples, including
sugars. On November 21st Dr. Tattersall called on me
again, and for the first time suggested that arsenic might
be present, being conveyed into the beer through the
hops. Up to this time it had not occurred to me in the
remotest possible degree that arsenic might be found in
beer. Dr. Tattersall also stated that the illness was
clearly traceable to the beers of a large number of
brewers, including ours. I wired to Mr. Gordon Sala-
mon with regard to the samples sent him: "Try for
arsenic." In consequence of the suggestion made by Dr.
Tattersall that the arsenic might be conveyed through
the hops, I immediately gave instructions for all the
hops we used to be analysed; and Mr. Stone, our chief
brewer, conducted the analysis the following day, but
found no arsenic in them. Mr. Stone is a Fellow of the
Chemical Society, and a practical brewer of long expe-
rience. We have a well equipped laboratory for the
purpose of examining the materials used, in which, up
to that time, we never dreamt of looking for arsenic.
On November 22nd I travelled up to London, and had an
interview with Mr. Salamon the same day. When I
arrived, he had only had time to test one sample, which
I afterwards found to be one of our own beers, and in
this he found no arsenic. I might also say that he had
conducted experiments up to a certain stage in following
out the first theory raised by Dr. Tattersall and Dr.
Cran with regard to higher alcohols; but when I
informed him of the arsenic theory he stopped those
investigations. We had a long consultation, and finally
came to the conclusion that the matter was ex-
ceedingly serious, and, if Dr. Tattersall was correct,
an exceedingly widespread thing. It was not a matter
for myself, as an individual, to investigate any further
alone, but one which concerned the whole trade. Dr.
Tattersall having informed me that it was not localised
to any particular beer, but extended to a large number
of cases in his district—that is to say, it was traceable
to a very large number of breweries. Mr. Salamon
agreed with me that the brewers ought to spare no ex-
pense or trouble to sift the matter to the bottom, and
render all possible assistance to the authorities; that
we should secure the best legal and expert advice; and,
with his approval, I decided to recommend that the
brewers should engage Mr. Fletcher Moulton, K.C.,
M.P., as counsel, and himself as analyst. We also dis-
cussed the names of several medical and scientific ex-
perts to form an advisory committee. I returned to
Manchester the same day, and wired from London, just
before leaving Euston, to several Manchester brewers,
and telephoned to others the following morning, Novem-
ber 23rd, and arranged for the Chairman of the Man-
chester Brewers' Central Association to call a special
meeting the same day. On November 23rd, at 12.30,
Dr. Kelynaek called on me. He had received through
Dr. Forsyth, who is the medical officer to our Brewery
Men's Sick Club, certain samples of materials used in our
brewery, Dr. Forsyth having previously asked from me
and obtained permission to take them. Dr. Kelynaek
informed me that he had traced the arsenic, not to hops,
but to invert sugar—in a sample procured from our
brewery through Dr. Forsyth. We purchased the invert
sugar from Messrs. Bostock and Co., of Liverpool. On

hearing Dr. Kelynaek's statement, I at once ordered that
Bostock's invert should be discontinued, and not an
ounce has been used since. That was following out the
third suggestion of the cause of illness produced by the
beer, and again I at once took action on the suggestion.
We afterwards returned the balance of stock to Messrs.
Bostock, keeping a cask of invert and a bag of glucose
as samples for reference. Dr. Tattersall called within
a few minutes of Dr. Kelynaek, and he had discovered
arsenic in the glucose also, I believe. I gave him the
name of the manufacturer, and he said he would see Bos-
tock's at once. Mr. Stone, our chief brewer, the same
afternoon (November 23rd) conducted experiments, and
found varying traces of arsenic in both Bostock's invert
and glucose. Some was badly contaminated, other
samples only very slightly. The only two other sugars
we used were found to be free. On the same date a meet-
ing of the Manchester Brewers' Central Association was
held at three o'clock. I laid before this specially sum-
moned meeting the result of my investigations; and a
sub-committee was appointed, consisting of the Chair-
man and representatives of six breweries of the district.
A resolution was passed thanking me for my
prompt action, and I was authorised to wire to
Mr. Gordon Salamon engaging his services as
analyst, and Mr. Fletcher Moulton as counsel.
After the meeting I called upon Dr. Miller, Ph.D.,
F.I.C., F.C.S., and engaged him to examine all our
beers in stock, as well as brewing materials, and all
brews before delivery. Being put on the track, we did
not, from that moment, send any beer out at all that was
not analysed and certified by him. This has been con-
tinued up to date. On November 24th Dr. Miller found
traces of arsenic in some of the samples of beer sub-
mitted to him, whereupon we suspended delivery imme-
diately. All the beer in stock at our breweries was
analysed by him, and that which was found to be con-
taminated we destroyed in the presence of the Excise
officers. We have not sent out any since without the
brews being analysed and certified by Dr. Miller, as pre-
viously stated. We also took every precaution to stop
the sale of the beer that was in the hands of our custo-
mers until we had been able to have samples analysed.
The beer in customers' hands of all brews that were not
certified free from arsenic we either turned into the
sawers or brought back to the brewery to be destroyed.
Altogether, the contents of many thousands of barrels
were destroyed, the value of the beer and stout thus
dealt with being not less than £15,000. We also took
every precaution with regard to having the brewery
plant thoroughly purified and examined to see that there
was no remaining contamination. Dr. Salamon has
examined our plant, and taken shavings from the insides
of our casks, which after analyses he reported to be free
from any traces of arsenic. On November 25th I met
Mr. Salamon at Mr. Fletcher Moulton's house, together
with Mr. Weld Blundell (Vice-Chairman of the Man-
chester Brewers' Central Association), who lives in Lon-
don. After a long discussion of the matter, it was
decided that we should recommend the appointment of
an expert committee to advise the brewers, and assist
the authorities in the investigations, consisting of Sir
Thomas Lauder Brunton, Dr. Luff, Dr. Stevenson, Mr.
Fletcher Moulton, K.C., M.P., and Mr. Gordon Sala-
mon. Dr. Samuel Buckley, of Manchester, and Mr. C.
P. McKeand, Barrister-at-Law, were added later. I
returned to Manchester at 10 o'clock the following morn-
ing. On November 26th a meeting of the Special Sub-
Committee of the Manchester Brewers' Central Associa-
tion was held in the afternoon, at which my action was
approved, and the committee of experts appointed.
On and from November 26th a copy certificate of purity
has been attached to each barrel of beer and stout sent
out from our breweries, all brews having since then been
analysed by Dr. Miller. At a meeting of the Sub-Com-
mittee on November 27th I submitted a copy of the certi-
ficate* that we were attaching to each barrel sent out,
and its form was approved and recommended for general
adoption. On November 28th Dr. Luff and Mr. Gordon
Salamon came to Manchester and remained until the
30th. They were joined by Sir Lauder Brunton and
Dr. Stevenson on the 29th, and the Brewers sub-com-
mittee sat daily to confer with them. The expert com-
mittee have made many visits to Manchester, and the

Mr. J. G.
Groves, M.P.
7 Mar. 1901.

Destruction
of contaminat-
ed beer.

will be sent
to the
analyst at
once.

Testing of
new beer.

* "I certify the purity of the brew of beer from which
this cask is filled."—(Signed) A. K. MILLER, Ph.D.,
F.I.C., F.C.S., the Laboratory, Withy Grove.

"GROVES AND WHITNALL, LIMITED."

Mr. J. G. Groves, M.P. Brewers' sub-committee have been in constant communication since.

7 Mar. 1901.

1552. Did your brewery take any further steps to recall contaminated beer, and replace it by beer which was free from arsenic?—As to further action taken at the breweries of Groves and Whitnall, Limited, on November 27th we issued a circular* to all our customers, asking them to cease selling (or using) any beer in stock until further examined. Our travellers also immediately commenced to visit customers with lists of certified brews. Those which were found to be right had a certificate of purity attached to the casks. All others, pending results of further analyses, had a red label affixed—"Not to be used till further examined." On this day some 20 travellers and clerks were sent out to expedite the above work, which was followed up from day to day; and as quickly as possible stocks were replaced by certified beer, and the old stock destroyed on the premises or removed and run into the sewers at the brewery, as previously explained. Many of our houses had to close until stocks were replaced. Some time was occupied in completing the removal and destruction of so large a quantity of beer. In view of this, we issued a second notice† to all our customers on December 1st; and on December 12th, with a view to ascertaining if we had got rid of all contaminated beer, or what quantity, if any, there still remained in customers' cellars on which had been placed the embargo label "Not to be sold," we sent out a further circular.‡ When I brought the matter before the Manchester Brewers' Central Association, they agreed to recommend to their members' action on the same lines that my company had adopted at our breweries. The Association called meetings and issued circulars advising members to follow out what we had done.

1553. Then we may take it that your firm has throughout taken the initiative in this matter, and the other Manchester brewers have followed what you have done?—I think that may fairly be taken as correct. There is no doubt about it.

1553a. You have, no doubt, rendered all the brewers who acted so a great service?—I hope so. It has been very much to our own detriment, but I hope it has been of permanent service.

Use of Bostock sugars in this brewery.

1554. Can you tell us to what extent Bostock's sugar was used in your brewery?—I may say that Bostock's is the only sugar in which we have discovered arsenic. For some time previous to August, 1900, we had not used Bostock's glucose, but that of other manufacturers. Garton, Hill and Co., of Battersea, with whom we were then dealing, being very busy, asked us to suspend our orders, and we then, to oblige them, commenced to take Bostock's, resuming with Garton's about the middle of

* "Our customers are aware that every cask of beer that now leaves our brewery has a certificate of purity attached. We must, however, ask them, under no conditions, to sell any beer they now hold in stock, which, although it probably may be perfectly pure, has not yet been certified, until we are able to attach the necessary certificate to each cask, and we are taking immediate steps to enable us to do this. We are adopting prompt measures to analyse every brew in customers' cellars, and hope to be quickly able to certify the purity of same."

"GROVES AND WHITNALL, LIMITED."

† "It will of necessity take us a considerable time to fetch back from our houses the stock of uncertified beer which was there on Tuesday last, and which by our letter of that date we directed should on no account be sold. We, therefore, think it prudent to repeat the direction we then gave, and to point out that we shall regard it as a serious breach of duty on the part of anyone who permits any of that beer to be used or sold under any circumstances whatever, and further, that whoever does so will incur a grave personal risk."

"GROVES AND WHITNALL, LIMITED."

‡ "We shall be greatly obliged if you will state on the enclosed post-card, by return post, the quantity and qualities of beer you may still have in your cellars upon which we have placed the embargo label "Not to be sold." If your cellars are all clear, i.e., that the ale has either been returned or run down the drains in your cellars, please say so. It is imperative we should have this reply by return of post. Please state address in full when replying."

"GROVES AND WHITNALL, LIMITED."

November, just before the discovery of arsenic in Bostock's goods. The price of the three makes of "glucose" we had used was absolutely the same. The "invert" sugar (Bostock's) was dearer than glucose by over £4 per ton. This was only used as priming for the single X beer; that is to say, we used the dearest material in the cheapest beer. I think that during the year 1900 our total consumption of Bostock's glucose, as compared with other glucoses, was 8 per cent. of the total; but, unfortunately, to oblige Garton, Hill and Co., we used what would otherwise have been our consumption for the whole year in the two or three months between August and November. Had it not been for that we should have been entirely out of this scare, except as to the question of Bostock's invert, which we were not using at the time we commenced. The percentage of Bostock's as compared with our total consumption is 8 per cent. of the whole during the year, and that was used during the time I have mentioned.

1555. You have spoken of three makers of glucose—Bostock's, and Garton, Hill and Co.—who is the other maker?—The third glucose is called "Climax." It is a very well known sugar, and it was referred to by Mr. Gordon Salamon this morning.

1556. Is "Climax" the name of the factory?—No, the name of the brand.

1557. Who are the makers of that brand?—It is imported from America. It is a high-class sugar, and always stood very well in the market. It has been analysed by us and by every other maker, and I believe has been found to be perfectly pure.

1558. Was it glucose or invert sugar?—It was glucose.

1559. Was the glucose that you used in brewing from August to November Bostock's?—Not solely; from August to November we were using both "Climax" and Bostock's glucose. We should not have been using any of Bostock's at all had it not been to oblige Garton, Hill and Co. To oblige Garton, Hill and Co., who were very busy, we turned to Bostock, and then we got Bostock's glucose in some of our beers.

1560. You were priming with Bostock's invert. How long had you been using that?—We were priming one quality of beer only out of about six. We used priming only in one beer; and therefore we only used Bostock's invert in one beer; all the other beers would have been free.

1561. How long have you been using Bostock's invert for priming beer?—I should say for four or five years.

1562. And have you continued to use it?—Yes, up to the time of this discovery we had used it continuously.

1563. Can you tell us what weight of invert sugar would be added to a gallon of beer as priming?—I cannot tell you that exactly; but I can tell you how much of the solution we add. We follow the Excise regulations, and add half a gallon of solution made from the invert sugar, the specific gravity of which is laid down by the Excise at 1150. That is added to the beer after it is brewed. To 35½ gallons we add half a gallon of such priming, making 36 gallons.

1564. Was the priming always invert sugar, or invert sugar and glucose indiscriminately?—It was a solution made from invert sugar only.

(Professor Thorpe.) I can supply the information, if it is wished, as to how much actual weight of invert sugar was used in the priming. It was 1 9-10th lbs. of invert sugar per barrel.

(Chairman.) Of this particular priming?

(Professor Thorpe.) The priming that Mr. Groves says has a specific gravity of 1150°.

(Witness.) I was going to say from 1½ lbs. to 2 lbs.

1565. (Chairman.) Since discrediting Bostock's sugar, what other action have you taken?—From the time of our attention being called to the matter, we have required certificates of purity to be furnished to us of all materials used in brewing, and we have conducted careful and minute analyses ourselves, and submitted samples of everything to Dr. Miller, and also many to Mr. Estcourt, the public analyst for the City of Manchester.

1566. Is a private analyst employed by you?—Dr. Brewster is the analyst I have referred to, and Mr. Estcourt is the public analyst. We employed him privately as a further precaution.

1567. Has the question of the possibility of malt being contaminated with arsenic ever been brought to your

Mr. J. G. Groves
7 Mar.

America
glucose
used.

Priming

Dr. Brewster
Public Analyst

notice?—Early in the month of December Mr. Estcourt publicly reported traces of arsenic in malt he had examined. This caused us to submit our samples to him and to Dr. Miller. From that time we have discarded doubtful samples, and brewed only from those certified safe. We have found that malts cured with ordinary gas coke are generally contaminated, and those from anthracite coal were free, or practically so. Brushing and polishing the malt causes a great improvement, and is a necessary safeguard.

1568. Is it a necessary safeguard if anthracite is used?—You may say that it is an additional safeguard, but in the case of malt not kilned entirely with anthracite coal it should be an absolute safeguard, because some malts are kilned with anthracite up to a certain point, and coke is used afterwards, or in conjunction with anthracite. We require this to be done with all our malts, and insist upon a personal guarantee of purity from the maltsters with each separate consignment. We insisted upon every invoice being separately and specifically guaranteed.

1569. (Dr. Whitelegge.) Guaranteed as what?—As free from arsenic.

1570. (Chairman.) Do they mean that no arsenic can be detected in a pound of malt?—Yes, by analysis. They guarantee by analysis. The malt was proved to be free from arsenic.

1571. So that in a pound of malt no arsenic whatever can be detected. Do they guarantee that?—It has to be passed free. It has to pass the analysis free from arsenic. That is the condition of the guarantee.

1572. How much is a consignment of malt, and can an analyst by analysing a single sample tell whether the whole of the consignment is equally safe?—That opens up rather a wide field. I am bound to say, in justice to the maltster that it is quite possible. The lumes which convey the arsenic might impinge upon a certain part of the kiln, and not upon other parts of the kiln; but we take a large number of samples from, say, a consignment of 100 or 200 quarters; we take a large number of samples from various numbers of sacks, mix them all together, and take an average sample out of this total. We have gone to immense pains in the matter, and we have spared ourselves no trouble. I think that is the fairest way of doing it. If that sample passes through, we consider it is a fair indication that the whole lot is free.

1573. When did you think the danger ceased so far as your beer is concerned?—So far as sugar is concerned, in my opinion the danger to the whole trade ceased from the time that the mischief was located to Bostock's materials. In our case it has ceased from the 23rd of November—that is, from the date it was brought to our knowledge.

1574. (Sir William Hart-Dyke.) You would have no hesitation, with proper safeguards as regards analyses, in using sugar, either invert sugar or glucose, provided it had not come from Bostock's?—Quite so. We have found no arsenic or trace of arsenic in any sugar but Bostock's. If I wanted to be quite sure that I had an absolutely free material, I should unhesitatingly select sugar as being a free material.

1575. Then you have no doubt whatever that the whole of this mischief has been caused through the medium of this material sold by Bostock as passing through Bostock's hands?—So far as my own knowledge goes, I should say unhesitatingly that the sickness and deaths had certainly been due entirely to Bostock's sugar. As to the smallest trace which may be found in malt, I am not able to say whether it might have caused any damage. I should say not. I should say that traces from malt would not be likely to be detrimental to public health except where there was gross carelessness.

1576. I think you said that the action which you have been taking in this emergency has been very detrimental to your own interest?—I mean in this way. Our name got associated with the "arsenic scare," to use a local expression, at a very early stage, and the public, no doubt, at the first stage jumped to the conclusion that ours was the only beer contaminated. It takes a long time to eradicate a misconception of that kind. It is in that way that I think we suffered considerably more than we have deserved.

1577. You would rather that it had been spread over a larger surface?—The blame has not been spread as it ought to be.

1578. You have been going through a very grave anxiety in addition to loss owing to this crisis?—Yes.

1579. I believe you have applied your utmost energy during all these anxious weeks to secure the consumer to the best of your ability?—Yes, most certainly; I have not spared anything.

1580. In answer to the Chairman, I think you indicated certain safeguards for the safety of the consumer in the future. Did you mention any safeguards with regard to the immediate crisis through which we have been passing which you would like to indicate for the future?—My first anxiety was to get over the immediate crisis and to stop the mischief, which was no doubt very widespread. Having done that—and I think we have largely done it by discovering the source of the mischief—I think the results of the investigation have opened our eyes and the eyes of the whole scientific world to facts which were not previously within our knowledge. Those facts having been made public and brought to our knowledge, I think we ought to take every possible lesson that can be gained from those crises, and apply it to our manufactures in the future. Certainly, as far as I am concerned, we shall continue to use the safeguards we are now using, for fear of any possible relapse, although I do not doubt, now that everyone's attention has been called to the possibility of arsenic contamination, that that possibility will become less and less as time goes on, if it has not already disappeared.

1581. You have given us the form of certificate which has been in use since the outbreak occurred: "I certify the purity of the brew of beer from which this cask is filled." That is signed by Dr. Miller. Is that from your own laboratory?—From Dr. Miller's laboratory. I may say that in addition to sending these samples to Dr. Miller, we test everything now for arsenic, especially raw material. At every stage of the process, right through, Dr. Miller takes a sample. He takes samples, and he certifies these samples; but we take additional precautions ourselves.

1582. (Mr. Cosmo Benson.) Where are the samples collected?—At the various stages of the brewing. Dr. Miller gets them at every stage—as soon as the beer is run down into the fermenting vessel, and before the yeast is added to it. If there is any contamination, it will be worse then than it would be probably at a later stage. He takes the samples at the same time as the Inland Revenue officer does.

1583. (Sir William Hart-Dyke.) I suppose at the finish another sample is taken?—We take samples ourselves right through the brew. The sample we give to Dr. Miller is at the worst stage, the most likely stage in which anything would be found.

1584. Are you content to argue from that that there is security so far as the finished article is concerned, or do you take another sample when the beer is fit for drinking?—We take a sample when the beer is ready to rack into the cask—at the finish of its fermentation.

1585. (Professor Thorpe.) Dr. Miller's certificate has nothing to do with that, has it?—We consider that if we get Dr. Miller's safeguard at the early stage, we can safely trust to our own samples at a later stage, when there is much less liability to contamination.

1586. (Mr. Cosmo Benson.) After Mr. Miller's sample is taken, you add the priming?—Yes, in the racking square.

1587. That is the only addition you make?—Yes. The priming is made from sugar which has previously been passed as absolutely pure.

1588. (Sir William Hart-Dyke.) Although we may be all anxious, and Parliament may be anxious, not to interfere with any trade such as the brewing trade, yet after such a grave disaster as has happened, affecting human life to such a great extent, you must expect that some very strong guarantee must be afforded with regard to the future, must you not?—Most certainly.

1589. Have you anything to suggest in the shape of such a guarantee beyond the certificate of purity, a copy of which I have just read to you—such a guarantee of purity, I suppose, resting on the basis of other guarantees given to you respecting each of these class materials which you have employed; is that running through your mind?—Yes.

1590. Will you tell the Commission the process you have in your mind as regards some guarantee for the future? In the case of maltsters, for instance, would you insist on a personal guarantee with regard to the purity of the malt?—I have no particular scheme in my mind except such as may be based upon the evi-

Mr. J. G.
Groves, M.P.

7 Mar. 1901.

Precautions
as regards
arsenic will
be continued.

Each brew
now tested.

Mr. J. G.
Groom, M.P.

7 Mar. 1901.

dence I have given, and upon the precautions which we have adopted. If Parliament were to lay down, or the Commission were to recommend, that we should continue for all time to attach some such certificate as this, or even the modified form "Certified pure," or even if Parliament or the Commission laid down that no certificate at all was necessary, I think that all brewers would take precautions in their own breweries and in the purchase of materials which would absolutely prevent any possibility of a recurrence of the mischief from this cause.

1591. That may be so; but the trade, of course, will be very anxious now as regards security after the crisis through which they have passed?—Precisely.

1592. Would there not be a general feeling, when that anxiety has gradually worn off, that there might be a period of carelessness, when a disaster might occur again, and that, therefore, something more than the efforts we have suggested might have to be resorted to?—I think in the future no brewer would be able to shelter himself under an excuse either of carelessness or want of knowledge. As far as want of knowledge goes, I consider the whole brewing trade has had no knowledge at all or any possible suggestion of this danger. I think that will not at all apply to the future, and that even if no guarantees were exacted, every brewer for his own protection, and for the protection of the public, will exercise, and continue to exercise, precautions exactly as they are doing now.

1593. You think, then, in fact, that no brewer in the future would ever think of using what might be a doubtful material?—Quite so.

1594. I apprehend you mean a material which had not been thoroughly tested by accurate analysis?—The materials of which he is not absolutely sure.

1595. As tested by accurate analysis?—Yes.

1596. Carried out by himself or guaranteed by the firm who supplied it?—I should say both.

1597. (Sir William Church.) Had you been aware of any illness among your employees before Dr. Cran spoke to you?—I had already seen Dr. Forsyth, our club doctor (I mentioned his name as having obtained samples) two or three weeks before this date; not that I had any idea in my own mind, but I had heard a rumour in the place. When I came to look through our list of men, I found several of them were off, apparently more than the average, with a form of influenza. I called upon Dr. Forsyth to ask him if he considered this was due to any special cause. It never entered my head for a moment that it was due to beer.

1598. But still there were a larger number of your employees off duty than the average?—Yes.

1599. Did he mention to you what their symptoms were other than saying he thought they might have influenza?—No; he said he thought they had been rather careless. He told me that this sickness was confined largely to the men who exposed themselves to the weather—that is to say, the outdoor men, and to those who take rather too much to drink. He said: "If you get them together and advise them for their own benefit to take less drink, and keep a strict hand upon them, it will be better." Shortly afterwards I had occasion to meet them at a large gathering—it was after my election—and I took the opportunity of saying a few words to them, begging them that if they felt they had symptoms of influenza they should report themselves, stop all drink, and go in for Bovril and other nourishing, warm food, and take extra care of themselves.

1600. You do not know from the information which Dr. Forsyth gave you whether your employees had any marked gastric symptoms, diarrhoea or sickness?—Not at that stage.

1601. What amount of drink are your men allowed?—They are allowed three pints of light beer a day.

1602. But I suppose practically they get as much as they like?—The outside men do. That is one of our difficulties. The customers are rather inclined to what is called "treat them" when they deliver beer. In that way the outside men get more drink than they ought to have. I may say that we do not allow drunkenness in the place. We are very strict about that. But some of these outside men, in spite of all our precautions, do get more than the average.

1603. How do you account for no arsenic being found in the sample of your beer which Mr. Salamon examined?—That would probably be a sample of sixpenny

beer, into which Bostock's sugars did not enter at all. It was only fourpenny beer which we primed.

1604. What about the glucose?—It was not Bostock's glucose; it was the American "Climax" glucose.

1605. (Mr. Cosmo Benson.) Brewed with glucose and not primed at all?—That is so. We do not prime anything except the single X beer.

1606. (Sir William Church.) It struck me that as your other beers were contaminated, how was it that this one was not contaminated?—We had a large number of brews which were not contaminated at all—large numbers of brews which were certified pure by Dr. Miller; but these were brews of the other grades of beer, and not the fourpenny beer. It was the fourpenny beer which was largely contaminated because of its having invert priming in it.

1607. Would these beers be brewed in the same vats as the other qualities of beer?—They might be, but, generally speaking, certain types of vessels are used for the same type of beer week after week. Usually the same quality of beer passes through the same vessels.

1608. Probably the cheaper beer, the fourpenny beer, would always be made in the same wort tubs and vats?—A good many brews are fermented in slate vessels. That particular type of beer to a large extent is fermented in slate vessels.

1609. These different qualities of beer are not manufactured in the same vats, are they, because if they are it would be a remarkable thing that some beers should have traces of arsenic in them and others not?—One would think they would get traces from the vats?—The precautions taken when the vats are emptied are very great. Every vessel is scalded and cleaned.

1610. Did you use any other invert for priming than Bostock's?—No; we have used Bostock's continuously for four or five years.

1611. Absolutely Bostock's?—Solely Bostock's for priming—that is, Bostock's invert.

1612. Had you ever tested the sugar for its quality or purity during those years?—We constantly tested for its quality, but we never tested for arsenic.

1613. You only tested it for its quantity of sugar?—Sugar is its commercial value. One thing we guard against in stantly sugar is that we have not got a sugar which, roughly tested speaking, carries forward a burnt flavour. If you test brew with a sugar that tastes a little burnt, you are apt to think that the acid has not been sufficiently neutralised by the lime which is added afterwards in the process of manufacture. If that were detected, we could immediately stop the use of it, and complain. For many years, to my knowledge, we have not had any samples reported as being insufficient in the manufacture in this way.

1614. It never occurred to you, I suppose, to examine it for anything which might be deleterious?—You only examined it so that it should be suitable for your own purposes?—Quite so.

1615. Had you any difficulty in obtaining warranties of pureness from either the maltsters or sugar makers when you required them?—We had not the slightest difficulty in getting warranties from the sugar makers. The maltsters were in very great alarm indeed; but we were firm, and we got the guarantee. Where they held back and did not give us a guarantee, we closed the account. We said: "Your malt may be perfectly pure, but we are under such a strong light of suspicion now as a firm that we cannot afford to forego any possible safeguard, and although every grain of malt in the kingdom may be perfectly free, so long as the public analyst has called attention to the malt, we must have your guarantee or we will close the account."

1616. Your experience would rather go to show that there is no great difficulty in getting guarantees from maltsters?—I think now they have all fallen into line with the exception of one firm, and I do not know whether within the last week that firm has not also come into line.

1617. (Chairman.) Your insistence upon a guarantee from the maltsters was after the scare, I suppose?—Yes.

1618. Before that it had not been considered necessary to have a guarantee of purity from the maltsters, had it?—No. My own personal, practical knowledge of the value of malt was quite sufficient to judge the samples, but when it came to a question of purity from arsenic, we considered that we certainly ought to have

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J. G. an absolute guarantee that could not be got round in any way.

1619. And that guarantee implied purity from arsenic, special notice having been called to that?—That it shall be free from contamination by arsenic or other deleterious materials.

1620. (Sir William Church.) There are other things used in brewing, I believe, besides glucose and invert sugar—hop substitutes?—We never use them.

1621. Then you can give us no information with regard to them?—I can give you no information at all. We use hops only.

1622. (Dr. Whitelegge.) Did you obtain any certificate with the hops?—At the time we got certain certificates from the hop merchants; but I understand that the whole trade has met together since and sent a circular round to all their customers saying that they consider it is unfair of the brewers to ask them for a guarantee of an article over which they have no control, in the growing or in the treatment or in any process until it reaches their hands.

1623. (Sir William Church.) That is the hop merchant—Yes, the man from whom we buy.

1624. (Professor Thorpe.) The certificate of purity issued by Dr. Miller, which you have explained to us, has reference practically to the wort only, has it not?—Yes. This particular certificate is attached to the cask.

1625. Do you imply that it is a warranty to the licensee?—It is a warranty to us, and we pass it on to the licensee, not with the idea of getting rid of our own personal liability or guarantee in the matter, but with the idea of assuring the customer that we have taken all precautions to obtain the best scientific certificate we can.

1626. The legal position of that certificate is that it refers not to finished beer, but to some substance which is in an intermediate stage?—It is the finished beer with the exception of the priming. That is what you mean, I suppose. Dr. Miller, besides, gets frequent samples of the beer taken from the cask as well but we thought if the certificate applied to the beer at a stage where arsenic was most likely to be found, if at all, that that would be an extra precaution, because we could not give him samples of every barrel of beer out of the thousands and thousands of barrels in a week. We could not give him a sample from every particular cask, so he used the words: "I certify the purity of the brew of beer from which this cask is filled."

1627. I should like, if we could, to get the legal value of this as a certificate. Would the licensee, whose beer was taken by an inspector, and was found to contain arsenic, be in a position to point to that as a warranty?—I should say that the licensee would look to us for any liability that he might be exposed to, so that if he had an action brought against him, he might be able to bring an action against the brewer.

1628. But would this enable you to be immediately connected with any police prosecution based upon the action of the public analyst?—From a legal point of view it is possible that it might not, because the legal action, so far, has been taken against the retailer. It may be perfectly legal, but I think it is very wrong and unfair. I think the brewer ought to be prosecuted, and not the retailer.

1629. But, of course, the action has been taken not upon the sample of wort, but taken upon the sample of beer; that is to say, action is taken upon something to which something else has been added after the certificate has been framed: is it not so?—Allow me to correct that. I think besides the sample which is taken at an early stage, although Dr. Miller does not get samples from every cask (he cannot do so) he has one sample from every brew after the beer is finished.

1630. I think we have been rather at cross-purposes?—May I say that where the misconception has arisen is that this invert sugar is not put into the cask. It is put into the racking tun—mixed altogether in the racking tun.

1631. That may be so, but it has been added to the material at a stage subsequent to that product which Dr. Miller's certificate has reference to?—Yes.

1632. Therefore to that extent the certificate is not valid so far as the finished beer is concerned?—I quite see your point. I think that besides many samples at

the early stage, Dr. Miller has one sample at the finished stage out of what I call the racking back.

1633. Your machinery for ascertaining for your own purpose, and even for the satisfaction of your licensee, is no doubt adequate. Dr. Miller analyses all along the line, and no doubt with sufficient stringency; but the point I am raising is as to the actual legal value of this certificate as a warranty?—I think we should be legally liable ourselves—we should have to prove that we had taken every precaution—and the retailer who retailed the beer would, I think, be able to come upon us.

1634. Do you think you might immediately, upon the strength of this certificate, be connected with any police prosecution which might be instituted on the ground of impurity in your beer?—I cannot express an opinion about that. I should say one ought to be; we should have no wish to shirk it—not the slightest. That is why I ventured to express an opinion, which perhaps, I should not have done, that it is a shame that the retailer should have to bear the onus of a prosecution because, if anyone was innocent, he was.

1635. In other words, you have no desire under the particular form of this certificate, taken at that particular point in the history of the beer, to eliminate yourself from responsibility?—Most absolutely and emphatically not.

1636. I should like you, if you would, to give the name of the recalcitrant maltster—I hope you will give his name?—I suppose I am right in mentioning it. The maltster who objected to give the certificate in the first stage was Mr. Soames, of Grimsby—Messrs. A. and G. Soames. He considered it was unfair that he should be called upon to take what he considered was a very heavy responsibility.

1637. I think you have assured the Commissioners that you had no difficulty with regard to the manufacture of invert and glucose in getting these guarantees of purity?—Not at all; in fact, the guarantees are attached, gummed on to the invoices, and the dates of the invoices are stated upon the guarantees.

1638. Do they furnish you with these guarantees without being asked for them?—No. We sent a circular letter out to all the traders with whom we dealt, and they immediately responded. That was their own form of words. It was exactly what we wanted, and we have adopted it with other people.

1639. I gather that the guarantee was rather in the nature of a general guarantee of purity?—I do not know whether you have had a copy of what was sent out. It was the guarantee issued by Messrs. Garton, Hill, and Company. I thought the wording so satisfactory that we adopted it.

1640. Have you required all the others to adopt the same form of guarantee?—Yes.

1641. (Mr. Cosmo Bonser.) In Manchester?—The people with whom we trade.

1642. (Professor Thorpe.) I suppose it is within your knowledge that it is not the exact form adopted by the various makers and sellers of this article; you may have imposed it upon them?—Possibly we did. I should like to see whether our letter gives any suggestion as to the wording.

1643. The form of guarantee issued by Messrs. Garton, Hill, and Company is a form to which the signature of the analyst is attached, and it is countersigned by Mr. Richard Garton himself, I think?—I am not quite sure, but I believe it is.

1644. Anyhow, I take it from you that in your opinion the guarantee furnished by Messrs. Garton, Hill, and Company is sufficiently specific?—I think so.

1645. It is not a general guarantee, but it covers the individual deliveries?—Not only that, but in writing upon the guarantee there is a space left for the date of the invoice, and they state the date of the invoice upon it.

1646. That is to say, the guarantee actually connects the warranty with that particular delivery?—Yes. There is no saying that this is a general guarantee at all; it applies to that delivery.

1647. But the other guarantees are not of that order?—No; but we are getting them into line. At first there was rather a demur. Some people gave it so unreservedly, that I thought they did not know what they were doing. They gave it perfectly freely, so we put these words to them.

1648. I gather that, being satisfied with the direct character of the guarantee furnished by Messrs.

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Mr. J. G. Garton, Hill and Company, you have imposed a similar formula upon others?—Yes.

1649. Have you had any difficulty in getting them to do that?—We have only imposed this form lately. At first we were content with a general guarantee; but when we noticed the admirable form of Messrs. Garton, Hill's, we imposed it upon others, and, with the exception I have named, they immediately came into line.

1650. Do these guarantees accompany the invoice as a separate document?—Either that, or they are written upon the invoice.

How these guarantees might be systematically obtained,

1651. I gather you think it is desirable that this system should be perpetuated?—It is very possible that it might be wise to do so; but we have only imposed it for the present. It is not for me to dictate to the Commissioners as to whether it should be continued, but it would be a very wise precaution for the brewers. That is my view.

1652. Do you think it would be a wise and prudent thing that this system of giving these specific guarantees should be perpetuated?—I think so, because whatever form of guarantee the brewer gives, there is no doubt in my opinion that if not legally, he is morally liable. That being so, I think he ought to take all precautions necessary, and insist upon every cover he can possibly get as well.

1653. Even although you do impose a precisely similar formula upon every vendor of invert or glucose, you yourself have no knowledge to what particular test this formula applies?—No, I cannot say that I have; but I think it would be the Marsh test which is usually adopted.

1654. It may be one thing or another?—It might be, but it conveys to us that it has passed a satisfactory test, and that it is free from arsenic or any other deleterious substance.

1655. But who is the judge of the satisfactory character?—We check every delivery ourselves.

1656. You yourself use a test to see that the guarantee is fulfilled?—Many tests out of every consignment we get.

1657. You are in some respects exceptional. There are lots of brewers not so well equipped as you are with scientific assistance?—If they have not got it themselves, I think they are employing it. It is my view that they ought to do so.

1658. Has every small brewer the means of getting this?—I should say he would send a representative sample, taken from, say, half-a-dozen different bags, if it was glucose, to his analyst. I do not say that is being universally done now, but it would be wise if he did do it.

1659. I do not wish to deprecate any increased precaution or stringency that may be brought to bear but if this guarantee had reference to a standard test prescribed by some authority, and the certificate itself was drawn up in an approved form by an authority, and the certificate bore the signatures, first of the analyst and then of the man who was responsible for his employment, or in seeing that the analyst had done his duty, do you not think that would be a better way of doing it?—It possibly might; but in the case of a small brewer it is natural that he should take all the same precautions as a large brewer; but it would add very much to his difficulties.

1660. If he got a certificate, with the knowledge that everything had been done that ought to be done by the vendor of the article, to some extent his responsibility would be minimised, would it not?—Quite so. For his own protection he ought to have all these safeguards.

1661. These certificates could be attached to the invoices?—Yes.

and checked by Revenue Officers.

1662. And being so attached they would always be seen by the Revenue officers?—If they wished to examine them.

1663. They themselves see the invoices when they like?—Yes, but they do not ask for them frequently. Still they are there.

1664. That is to say, the Revenue officer in charge of the brewery would see these certificates of purity?—Yes.

1665. Would it be any considerable hardship upon you as a brewer if you were required to produce that certificate of purity obtained in the manner I suggest before you took into use any of these products?—It might, in this way—that sometimes a consignment of

goods will arrive with an advice before the invoice arrives, and you might want to use the goods immediately. If the Excise officer would not allow you to use the goods, even provided you had personally tested them, without seeing the manufacturer's certificate, it might cause delay in the use of the article.

1666. Supposing the matter were so arranged that you furnished the Excise officer with the proof that you yourself had tested it, he might not wait for the certificate?—He might. You would not use it yourself unless you were sure.

1667. In the event of the brewery not having a skilled assistant to test those products, and being, therefore, unable to give the evidence of purity to the officer, would there be any hardship upon that brewer being made to wait until the evidence of purity was forthcoming?—I think, perhaps, it would be simpler that he should be able to produce the certificate at once. If such a condition were laid down, I think it would simplify the matter for the small brewer to simply produce his certificate of purity. But in our case I should prefer our own examination first.

1668. I do not wish in any way to lessen that, but what is the difficulty about the certificate of purity going with the advice of the despatch of the goods?—That could be done; but I understand you want it attached to the invoice.

1669. I suggested that because it connects that particular certificate with the particular delivery?—Exactly.

1670. But would there be any great difficulty in getting both the invoice and the certificate?—Not always, but sometimes it might cause a little delay in the use of the raw material.

1671. You do not see any insuperable difficulty in getting the invoice and the certificate together, do you?—I think the invoice and the certificate ought to be together if it is to be of value to identify it.

1672. It should come simultaneously, or even prior to the delivery of the goods?—It should.

1673. Do you see any real difficulty in bringing that about?—There would be no other difficulty than that which I have named—that a man might require to use his materials quickly, and he would not at that time have received his certificate, although knowing it was there.

1674. Were these other sugars which you tested in your laboratory sugars which had been produced by the instrumentality of the oil of vitriol?—They were Garton, Hill's and "Climax."

1675. Then they were?—Yes.

1676. You have destroyed, as you have told us, a very Beer large quantity of your beer, and we at the Government Laboratory have of course received samples of beer relating to what you have destroyed?—Yes.

1677. I suppose you have no objection to my asking Claims you questions about the beer you have lodged for rebate return or drawback?—No, you may ask me anything you like. duty of some c

1678. I find that you had 31 brews from the 17th October to the 23rd November. Perhaps you do not remember these details?—We had very many more than that.

1679. You had many more than that, but you had 31 brews which were presumably brewed from arsenicated material?—Yes, 31 brews which contained Bostock's sugar. There were a large number which did not.

1680. You have not sent us any beers which were certified by Dr. Miller as being free from arsenic?—No. The beer we sent to you was beer, I presume, that we had run away, and which was certified by him as containing arsenic.

1681. Has every beer that has been sent to the Government Laboratory been examined previously by Dr. Miller?—I think so; either that, or else it contained Bostock's sugar; I think both. Certainly no beer has been sent to you that did not contain Bostock's sugar or that was not certified by Dr. Miller as being contaminated.

1682. Then there are 31 such brews over that time—from the 17th October to the 23rd November?—Yes.

1683. That was equivalent to about 4,010 standard barrels?—Yes. That is beer which had never left the brewery.

1684. That was the amount of beer that was produced?—Yes, but it had not been delivered to our customers.

J. G. 1685. Do you happen to know how much you actually destroyed of the beer which had not left your premises?
 Mr. J. G. —No, I cannot tell you that without reference.

Mr. J. G. 1686. I may tell you that the official paper shows that you destroyed 104,360 bulk gallons?—Yes; that is beer that had not been sent out of the brewery.

1687. Beers which had not left your premises?—Yes.

1688. But you had produced 144,377 standard gallons?—Yes—you mean actual liquid gallons?

1689. Standard gallons. I want to know what became of the difference. You turned out 4,010 barrels, but you only destroyed 2,899. What became of the difference?—The difference would be in the hands of the customers, and would be afterwards stopped and brought back and destroyed at the brewery, I presume; that is to say, these were portions of brews part of which was in the brewery and part in the hands of the customers.

1690. Are you able to assure us that practically the whole of the 1,000 barrels difference was either brought back by you or destroyed by your employees, or poured down the drains by your customers?—It is nearer 10,000 barrels. The thousand barrels would be the difference relating to these particular brews.

1691. I am speaking of your own firm only?—So am I. Those thousand barrels were a portion of those brews (to which that return relates) which had already left the brewery, and for which we made no claim. In addition to that, there were also thousands of other barrels of which no portion of the brew remained in the brewery, and which were found upon analysis were contaminated. We afterwards got them back from the customers.

1692. All I want to know is whether any considerable portion of that difference was destroyed by the publicans or by your employees?—The publicans themselves destroyed nothing; our employees destroyed everything. It was either destroyed in their own places or it was carted back to the brewery and run down the drains.

1693. Why should you cart it back to the brewery?—It was very largely a matter of policy. It would have been less advertisement of a wrong kind to us if we had quietly run it down the drains of the customers, as many did, and not brought it back at all. But we thought the proper way of dealing with it was to take it clean away from their cellars, and run it down the drains ourselves. As a matter of fact, either my co-directors or myself, or our chief brewer, were there practically day and night to see, and to make sure, that the whole of it was run away.

1694. Have you any idea as to how much arsenic there was in those products which you used—the invert and the glucose?—I have not got the exact figures. They were in varying degrees of contamination. Some were very seriously contaminated, and others very slightly.

1695. Were the samples of the brewing materials taken by our Revenue officers taken with your knowledge?—I think so.

1696. Do you know the particular samples they took?—Yes; I should know at the time.

1697. Were those samples more than averagely contaminated with arsenic?—I should say you might take them as average samples.

1698. Does it strike you as a large amount, that invert should contain 1·6 grains of arsenic per lb.?—I think I have heard those figures as being the result of an analysis of a sample of Bostock invert.

1699. And does it strike you as a large amount that glucose should contain 2 grains per pound?—That, I should think, would be a very bad sample, because our own tests revealed the fact that it varied very considerably.

1700. Then the sample we got was not a fair sample of what you have been using?—It was there for your officer to take. I do not know how many samples he took.

1701. You used, in addition to Bostock's glucose and Bostock's invert, certain other sugars, some of which you named, but some of which you have not named. I believe you used a certain amount of caramel?—Yes, we purchased caramel from Dutton.

1702. Do you know who made it?—I believe Dutton is the maker; at least, I have always understood so.

1703. Have you got any caramel from Herring, Giles, and Co.?—We have, but, speaking from recollection, I do not think we have purchased their caramel lately.

1704. Were those caramels examined?—Yes, they were examined for arsenic after our attention was drawn to it.

1705. I suppose they would be caramelised glucoses?—Yes.

1706. In the manufacture of caramel does the maker set aside the off-colour glucose to turn it into caramel; is he likely to do that?—That I could not tell you. I do not understand the process of the manufacture of caramel. It is a colouring material made, practically, of burnt sugar. The actual process of manufacture I do not understand.

1707. Bostock's make caramel, do they not?—I am not aware that they do. If they do I have never heard of it.

1708. Is it at all likely that if a sample of glucose had been stained by an unusually bad sample of brown oil of vitriol, that that off-colour glucose would be set aside and turned into caramel?—I should not think so.

1709. What is caramel mainly used for?—For getting uniformity of colour. If you have malts varying slightly in colour, and you want to have them exactly uniform, it is by the tintometer that you bring up the standard of colour by the use of a little caramel, if needed.

1710. At what stage is the caramel added?—In the copper. When you take your sample before you run off, you add a little caramel to get the colour.

1711. Is it likely that any process through which the beer is going would tend to eliminate arsenic from the caramelised material?—There would be a tendency to filter anything through the hops before it was run into the cooler. I should think the hops would act as a filter medium for anything of that kind.

1712. (Chairman.) Is caramel largely used in beer?—It would not be used at all in pale ales; but where you have varying colours of malt you use a little caramel to bring it up to the standard.

1713. (Professor Thorpe.) The invert sugar that you use for priming would, in the proportion that you use it, mean that you add to 36 gallons of beer 3 grains of arsenic?—It is possible that in some samples you might get that.

1714. You told me that you thought the 1·6 grains in the invert was an average amount?—Those were your figures. When you mentioned it I recollected that I heard that 3 grains were found in one sample, but I could not tell you whether it was an average, or whether it was below or above.

1715. I think you also told me that the sample taken by our officer was an average invert?—It was taken from a bulk of invert; but I could not tell you whether it was an average of the total. We found in our experiments that it varied very exceedingly.

1716. The glucose, but not the invert?—Yes; the invert too. That is to say, the amount of arsenic in the invert and glucose varied in the samples we took. Some were more highly contaminated than others.

1717. Assuming that 1·6 grains per pound was the amount of arsenious oxide in the invert, and assuming that you added to a barrel 1 9-10ths of a pound of this invert, you would have added something like 3 grains of arsenious oxide to the barrel?—Yes; if those figures are correct; but it is evident that it does not apply all round. We have had several samples, varying from 1-50th of a grain to 1-200th of a grain per gallon, in cases upon which prosecutions have been laid.

1718. In beers to which priming has been added?—Yes. Taking the sample of 1-200th part of a grain, that could not possibly have contained as much as you say; still, a prosecution followed. It is pending, and that was the certified amount.

1719. I do not put forward those figures as being of any other value except that they follow certain data that I have laid down?—It seems to me alarmingly high. I should not like to have it on my conscience that all this contamination had been as serious as that; in fact, I could hardly credit that it would be so.

1720. Has your chemist, Mr. Stone, or has Dr. Miller specially searched your products for selenium?—No; Mr. Stone has not. As far as I have heard of selenium, it is somewhat in the theoretical stage. We have heard it mentioned as a possible source of contamination.

1721. But you are not aware that Dr. Miller has caused any examination to be made with respect to it?—I think very probably he would have done so.

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Amount of
 arsenic added
 in priming
 with Bos-
 tock invert.

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1722. Would he have informed you?—He might have been experimenting to keep himself in touch with every theory raised; but personally I have not heard of this, except that in a general sense the theory of selenium has been mentioned.

Varieties of beer brewed. 1723. (Chairman.) What kinds of beer are brewed by your firm—several different kinds, I suppose?—Single X., mild ale; F., mild ale; XX., mild ale; C., mild ale; two strengths of bitter ale, and three qualities of stout.

1724. I think you said that the invert was only used as priming for the single X?—Yes, the single X quality.

Sugar used in given brew could be traced. 1725. Do your books show how much Bostock sugar may have been used in each particular brew?—Yes; our brewing books show exactly every ounce used in every form.

1726. As a general question, what proportion of glucose is there in each kind?—You may take it, roughly speaking, at about 10 per cent.; that is to say, it replaces 10 per cent. of malt.

1727. Nine-tenths of malt, and 1-10th of glucose?—Yes.

Amount of glucose in Groves and Whitnall's beers. 1728. As a general rule?—Yes; roughly speaking; it varies. It is as much as 12½ per cent. in some cases and as low as 8 per cent. in others.

1729. Would it be possible to make a good beer with glucose alone, instead of malt, supposing the glucose to be thoroughly perfect?—I should hardly like to go so far as to say that you could brew beer from glucose alone. I think it is very admirable in combination with malt.

1730. But not as a substitute for malt; but only as a substitute for a certain proportion of it?—Yes. We do not use it very largely. Some brewers use it very much more than we do. From 8 to 12½ per cent. is about what we use.

1731. Does the proportion remain the same all the year round in a certain kind of beer? Do you use different proportions in the summer from what you use in the winter?—We use the same in summer as in winter.

Certificates of freedom of beer from arsenic relate to Expert Committee's test. 1732. (Dr. Whitelegge.) You give a certificate with each consignment of beer sent out at the present time?—We attach a certificate fastened on to the barrel.

1733. What do you understand that certificate to mean? Does it mean absence of arsenic in a quantity detectable by the test of the expert committee?—It means that it has passed the test laid down. I may tell you that all our brews do not come within an approachable distance of the test, which is very much freer than the test we allow them to pass would show.

1734. So that you regard the test as a lenient one?—Yes; so far as we are concerned. We could pass a much stricter test.

1735. (Sir William Church.) You supply, I believe, a number of tied houses?—Yes.

1736. Of course, you had no difficulty in getting back the beer from those houses?—No.

1737. You also supply free houses?—Yes.

1738. Had you any difficulty in getting your beer back from them?—In many cases we had to use very great persuasion to get the people to understand that there was any danger, or that there had been any danger. They drew a sample of beer, and said, "Look at this; it is beautiful; do you want to ruin us, and close the house?" We said, "You will have to close the house if necessary, but you must not sell a gill."

1739. That would be with regard to tied houses?—Free customers as well. We had to use a good deal of persuasion. We said, "We are doing this for your protection, and for the protection of the public; you must not sell a gill." In some cases the travellers admitted when they reported to me that they had some difficulty in persuading people that it was not all moonshine.

1740. (Dr. Whitelegge.) Were any of those houses at a distance from Manchester?—Some were, but I may say that we do 86 per cent. of our trade within a 3-mile area of the brewery.

1741. (Sir William Church.) So that you do not think any large quantity of your accidentally arsenicated beer remained unwithdrawn?—No. We sent out a third circular on the 12th December as an extra safeguard, asking our customers for a return of anything still remaining in their possession. That brought out the fact that there were about 100 barrels out of the whole 10,000 remaining, and those were in outside places that we had not got at; they were lying there waiting to be removed. They were removed soon afterwards or destroyed on the premises.

1742. (Chairman.) I am sure the Commission feels that the public is indebted to you for your conduct through this crisis. Your prompt action on the 12th and 13th November has, I am sure, obviated much severe illness and saved many lives. Had it not been for the great promptitude of the action you took, we may believe the disaster would have been much more serious than it has been?—I am sure I am very grateful, my Lord, for that expression of opinion. It has lifted a very great load from my mind, for I am bound to say that I am so constituted that I perhaps take these things rather more conscientiously to heart than I should. I have felt that our company has perhaps suffered under a greater load of misapprehension than our neighbours; and while the extent of our business may have made us the innocent channels of a greater amount of trouble than some of our neighbours, I am glad to hear you say that you think the action we took at the time has prevented the mischief from spreading beyond the area in which it originally started.

Mr. E. W. T. Jones, called; and Examined.

Mr. E. W. T. Jones. 1743. (Chairman.) I believe you are a Fellow of the Chemical Society, and public analyst for the county of Stafford, and the boroughs of Wolverhampton, Walsall, Kidderminster and Newcastle-under-Lyne?—Yes. I have been a public analyst for about 28 years.

Samples tested for arsenic in Staffordshire. 1744. I believe you have tested many samples of beers?—Rather over 300.

1745. Previously to last December, have you tested many?—Not a very great many, only a few now and then as a public analyst.

Beer. 1746. And since last December?—I have tested about 300 samples; as a matter of fact, it is over 300 at the present time, because I have tested some since I wrote this report.

1747. Did you find many of these samples arsenical?—26 samples were decidedly arsenical.

1748. To the extent of what?—To the extent of from ½ to 1-20th of a grain.

1749. Per gallon?—Grain per gallon, calculated as arsenious oxide.

1750. The small quantity of one-sixtieth of a grain to a gallon, would that have escaped your test?—I do not consider so.

1751. Your test would have touched even one-sixtieth of a grain per gallon?—I consider so now.

1752. Thirty-three samples contained arsenic under one-twentieth of a grain per gallon?—Decidedly under one-twentieth of a grain per gallon, but 15 of those were from one brewer, after the use of Bostock's arsenical glucose had been discontinued; and I found that those traces of arsenic in those beers were entirely due to the malt used.

1753. Entirely due to arsenical malt and not to glucose?—Yes.

1754. Then these 15 were supplied after the brewer had discontinued the use of the contaminated glucose?—That was so.

1755. To what do you attribute the slight amount of arsenic in the other 18 samples?—In the other 18 samples they came from brewers who had previously used arsenical glucose; so whether these small traces of arsenic in these 18 samples were due to contamination left in the yeast, or from an arsenical malt, we have not been able to discover. But it is a curious fact that all came from brewers whose beer had been condemned for being decidedly arsenical.

1756. And as to home-brewed beers?—Every one of the home-brewed beers I found to be free from arsenic.

1757. Were the home-brewed beers made, generally speaking, from the same malt as the beer made by public brewers; was it obtained from the same sources?

Mr. J. Jones.
Arser non-I beer.

W. T. —This one particular malt which we have condemned came from Yorkshire. As a general rule, you found none of the home-brewed beers were arsenical?—That is so.

1758. Do you know what malts and what materials were used in the home-brewed beers?—I do not positively know; but inasmuch as I found no arsenical beer in any of our local breweries, except those which had used arsenical glucose, I presume that our local malts, at any rate, are free from arsenic.

1759. (Sir William Church.) What do you mean by "home-brewed beers"?—Beers brewed by the publicans themselves on their own premises.

1760. Very few private individuals now brew beer for their own use; those would be public-house keepers who kept small breweries?—That is what I take it to be from the information supplied to me. I would receive a sample, and I would get a note saying so-and-so is home-brewed beer. I took it that it was the publican who brewed upon his own premises.

1761. (Chairman.) I believe you have tested samples of malts?—Yes, thirteen samples of malt. Eight of those samples were from one maltster, three of which were decidedly arsenical, containing from one-fortieth to one-fiftieth of a grain of arsenious oxide per lb. The remaining five were slightly arsenical, with apparently less than one-hundredth of a grain per lb.—just detectable by the test. The five samples, representing three maltsters, local to Wolverhampton, were free from arsenic.

1762. Do you know what fuel was used?—I do not know what fuel is used in our districts; generally coke, I think, but I do not know what kind of coke. I have examined none of the fuel for arsenic, but I apprehend that it does not contain any sensible amount, otherwise I must have had the arsenical malt, or the arsenical beer from that malt.

1763. To what fuel do you attribute the arsenical character of the malt?—The arsenical malt in every case goes back to Yorkshire gas coke.

1764. Have you examined the constitution of that coke?—I have not; I have not been able to get a sample, but I have been promised one. It is rather out of my district.

1765. You have not examined any of the coal or coke in your district?—No, not for arsenic.

1766. Indirectly, do you form any conclusion?—Indirectly, I do not think that they can be sensibly arsenical, inasmuch as I must have condemned some of our local beers, or some of our local malts.

1767. You have not had any arsenical beer in the composition of which Bostock's sugar had not entered?—Except those private samples from the malt to which I referred.

1768. Have you tested the sugars?—I have tested 23 samples of brewing sugars, eight different makes, and in no case have I detected arsenic, with the exception of two samples of Bostock's. Those contained .023 and .021 per cent., or 1-10th of a grain per ounce; or, to put it as Professor Thorpe put it, 1.6 grains per pound.

1769. (Professor Thorpe.) Were those inverts or glucoses?—Both.

1770. (Chairman.) 1-10th of a grain per 1-16th of a pound?—Yes.

1771. That would be 16-10ths of a grain per pound?—Yes. I had one sample of Bostock's glucose sent to me privately that contained double that quantity—.05 cent.

1772. (Professor Thorpe.) Where did you get that sample from?—It was a private sample sent from Liverpool.

1773. Can you inform us how you got it?—It was sent to me by Mr. Collingwood Williams, of Liverpool.

1774. He was the County Analyst, I believe?—Yes. Up to that time I had come across no such sample of arsenical sugar, and I wrote to him to send me one which he was examining.

1775. That was a sample he was examining in connection with some of these inquiries, I suppose?—Yes.

1776. (Chairman.) Have you tested any samples of cane-sugar?—I have tested two samples of cane-sugar used for brewing, and both were free from arsenic.

1777. Have you tested any samples of treacle and golden syrup?—I have tested 25 samples which were all

free from arsenic. Some of the samples of treacle were adulterated with glucose syrup, but still they were free from arsenic.

1778. Would you consider glucose an adulteration of golden syrup?—Undoubtedly. A prosecution took place yesterday in our court on one of my certificates, and a fine was imposed.

1779. Do you think glucose would be an adulteration of treacle?—Undoubtedly.

1780. Have you tested samples of jams, marmalade, and mince?—Yes; I have tested 17 samples, all free from arsenic.

1781. Would glucose be an adulteration in jam or in marmalade?—I do not consider it would, though some analysts would.

1782. Is there any rule for the guidance of analysts with regard to adulterations such as that?—Only from common sense.

1783. (Dr. Whitelegge.) Which leads them to different conclusions?—Sometimes. I certainly think that glucose is a perfectly legitimate constituent of jam. There is no strict formula for jam.

1784. (Chairman.) Is it not also a proper constituent of golden syrup?—No.

1785. Is there a definition of golden syrup?—Golden syrup is a syrup run from a natural product; it comes from the refining sugar; but jam is a made-up article in which I apprehend they could use beet sugar or cane-sugar, or I should say they can use a certain amount of glucose if it improves the quality of their article to the palate or prevents crystallisation.

1786. Have you tested honey?—Yes.

1787. Would glucose be an adulteration of honey?—Undoubtedly I should condemn honey with glucose.

1788. Have you tested any samples of confectionery?—Yes. I have tested 27 samples of confectionery of various kinds and colours.

1789. Have any of them been of brilliant colour—a brilliant green, for instance?—Some were green. There were a lot of various colours.

1790. Were all those samples free from arsenic?—Yes.

1791. Was there any Scheele's green in any of them?—No. We used to have chromate of lead in sweets, but that has now gone. We have had a prosecution for that.

1792. Have you tested any sample of brewing materials?—Two samples of brewing materials. Two samples of bi-sulphite of lime, one of sulphurous acid, and one of finings. All were free from arsenic.

1793. What is your method of testing?—My method of testing is very similar to that recommended by the experts of the Manchester Brewers' Association. There is only a very little difference in detail.

1794. Do you think that such a small quantity as 1-20th of a grain per gallon could be estimated quantitatively by that test when that test declares that there is not arsenic; does it allow you to estimate so small a quantity as 1-20th of a grain per gallon?—Much less. I am quite sure I could detect 1-10th of a milligramme—that would be 1-36th of a grain in the quantity I use.

1795. Would that show crystals?—I should get distinct crystals from that.

1796. If it were 1-200th of a grain per gallon it would be impossible to see the crystals, would it not?—With that quantity undoubtedly, but we could increase the quantity of beer and bring it back again.

1797. If you took 2,000 c.c.'s instead of 200 c.c.'s you would see the crystals?—Yes.

1798. Have you used larger quantities than 250 c.c.'s?—I have not in a general way. The samples would not allow of my first making a qualitative test, and reserve a portion for a quantitative estimation, if requisite. I stuck to 250 c.c.'s.

1799. I believe you have described your method in the *Chemical News* of the 18th January this year (*Appendix No. 6*)?—That is so.

1800. And you have also described the process for obtaining quantitative results?—That is also described in the same number of the journal.

1801. Is it a very laborious and difficult process to obtain those results?—It requires very great care. It takes nearly two days to get at the results. The most scrupulous care is absolutely necessary.

Mr. E. W. T. Jones.

7 Mar. 1901.

Glucose an adulterant of certain foods.

No arsenic in coloured confectionery.

or sulphites.

Delicacy of test employed.

Mr. E. W. T. Jones. 1802. I suppose the Reinsch test, so far as it is specified in the report of the experts, could be completed within two hours?—Yes.

1803. Are the results you have obtained generally consistent with those calculated from the materials used?—Yes. Of course, I did not know until I got the report as to the key of what the material was that had been used. That is given in Dr. Reid's report to the Staffordshire County Council. In one sample I calculated that I should, if the formula given were correct, find .8 of a grain per gallon; as a matter of fact I only found .38—scarcely half. Another sample calculated from the materials given should have contained .51 grains. I found and reported .53. In another sample that should have contained by calculation .18, I reported .13. In another that by calculation contained .22 I reported .16. So that with the small quantities my results are very consistent with the formula. Whether I got hold of the particular beer with eight ounces of Bostock's glucose I cannot tell; at any rate, I did not get half the amount of arsenic that should have been in it had eight ounces of Bostock's glucose of the character I have experience of as being used.

Variation in quantities of arsenic in Bostock glucose.

1804. There is only one case in which there was so large a discrepancy?—That is all.

1805. Is it possible that arsenic can have been eliminated from the beer by the action of some other chemical constituent of glucose?—No. I think the discrepancy occurs probably from my not getting a sample entirely of this brew, or there was a variation in the character of the glucose that was used.

Usual nature of analysis by Public Analysts. 1806. (Sir William Church.) Before the question of arsenical poisoning arose in beer, were you in the habit of occasionally having samples of beer submitted to you for analysis?—Yes.

1807. When that was the case, for what purpose were these samples submitted?—For adulteration under the Sale of Food and Drugs Act.

1808. What used you to look for?—I never looked for arsenic.

1809. I suppose you looked for salt?—We always looked for salt. We generally look for hop substitutes, although we could not have done anything if we found them. We look for preservatives, salicylic acid. We have had one or two prosecutions in the case of salicylic acid. That was in lager beer, and not English brewed beer. Only in the case of salt and salicylic acid in my office as public analyst have I had prosecutions for the adulteration of beer.

1810. (Chairman.) How does salicylic acid get into the beer?—It is put into this light beer for the purpose of preserving it. They tried to persuade me that meadow-sweet was one of the natural constituents of lager beer, and that it got in naturally, but the magistrate did not see it in the same light as they did.

1811. (Mr. Cosmo Benson.) Have you analysed any temperance drinks for salicylic acid?—I do not think so.

1812. It came out before Lord Pembroke's Committee that considerable quantities of salicylic acid were used in temperance drinks?—I am afraid we can do very little with that at present. I may say that we get salicylic acid in quinine wine.

1813. (Sir William Church.) May I take it that when beer was submitted to you and other public analysts for analysis it never entered your minds to test it for arsenical or antimonial poison or anything of that sort?—No. In the first place, it is not really an adulteration; it is a contamination. Perhaps we ought to have sought for all these things, but a public analyst cannot seek for everything under the sun with the number of samples he gets, and I do not think it would be of very great avail if he did. It would limit his work to such a degree that his usefulness would be curtailed.

1814. (Chairman.) Do you not think that legislation which would increase the power of action, and the number of analysts if necessary, so as to secure the detection of contaminations, would be for the public interest?—I do not think so. I do not think that a public analyst will now have a sample of beer but what he will look for metallic contamination. I have known all my life that sulphuric acid has been contaminated with arsenic. As a chemist I know that it is used for the manufacture of glucose from starch, but I never thought that a manufacturer of glucose would use an arsenical acid for making a product, because it would re-act upon him if it were found out. It would be his ruin, as probably it will be the ruin of Bostocks. There is not

the slightest advantage in using arsenical acid, except, perhaps, the matter of threepence a ton in the price of the glucose made. The difference between arsenical and non-arsenical sulphuric acid is under five shillings a ton. It would only make a difference of threepence a ton on the glucose made. It is not worthy of consideration from a manufacturer's point of view.

1815. (Professor Thorpe.) We gather from you that practically the only arsenicated food or drink within the range of your experience is this particular beer brewed from Bostock's glucose?—That is so, except in the case of arsenical malts. It has opened that question up which I do not think we should otherwise have found out.

1816. Is it your opinion that there is no occasion for public anxiety with regard to food and drink being contaminated with arsenic, other than what we are immediately dealing with?—That is my contention. There is no cause for anxiety.

1817. In certain of these cases I suppose the articles you have examined have been produced, proximately or remotely, by the agency of sulphuric acid—the glucose, for example, in jams and marmalade?—Yes. I apprehend that almost all the glucose is made by the aid of sulphuric acid. For instance, the liquid glucose in jam is made from maize starch, with sulphuric acid.

1818. I presume you have selected the particular instances which you have given here on the ground that products in which oil of vitrol has entered into the manufacture may have been used?—I selected them out of my samples as simply bearing upon the question before you to-day. They were sent to me by the inspectors by the order of their committees.

1819. But what led them to the particular selection of the articles?—Very probably I should tell them that they had better go to so-and-so. The papers told them about the glucose.

1820. What led you to tell them to take samples of particular articles?—Simply to satisfy the public mind that any article that was liable to adulteration with glucose was or was not arsenical.

1821. In other words, it was the possibility of oil of vitrol remotely or proximately used in the preparation of these things which led you to select them?—Yes. A great many were selected by reason of our mayor being a medical man, and his reading the medical papers. He told the inspectors to get these things and submit them to the public analyst.

1822. Do you think there would be any practical difficulty in obtaining fuel for the malting kiln free from arsenic?—I do not know. I do not think we have any arsenical fuel in our neighbourhood, otherwise I must have fallen foul of some of the local brewers.

1823. (Chairman.) Do you think that the gas coke in your neighbourhood is free from arsenic?—I should say so.

1824. (Professor Thorpe.) Is the gas made in the neighbourhood of Wolverhampton and other places a highly sulphuretted gas?—There is a fair amount. The limit is 25 grains per 100 cubic feet—that is of sulphur in all forms.

1825. Is that more than the average amount?—It is considered a fair gas, I should think.

1826. I ask, because I suppose we may take it that there is a rough connection between the amount of sulphur in a coke, and the amount of arsenic which may be present?—Yes; that it to say from the pyrites present in the coal.

1827. I suppose in the original coal the arsenic present is a double sulphide of arsenic and of iron, is it not?—Yes, I should say so.

1828. Therefore *prima facie* a gas which was rich in sulphur might be derived from coal rich in arsenic?—It may be so. It is more likely to be than one with less sulphur in.

1829. The experience of the authorities where coal gas is made would be an indication of the quality of coke, as regards the arsenic which they turn out. Is not that so?—Yes; I think that some of our gas coke must be used by some of our local maltsters. In fact, I feel quite positive that it is. I have examined a number of locally made malts, and found no arsenic; therefore I presume that our gas coke is not arsenical—at any rate to any appreciable extent.

1830. What was in my mind is that a person buying coke, even supposing he used gas coke, would be able to draw a very fair inference as to the quality of the

Mr. E. W. T. Jones. 7 Ma

Select samples for public analysis.

Arsenical gas coke.

W. T. coke from the fact that the raw gas was or was not largely sulphuretted, would he not?—I think so, but I am not quite sure that it would be safe.

1901.

1831. It is a criterion, that is all. For example, if I wanted to buy coke for kilning purposes, I should take very great care to keep clear of it if I knew that it was produced in a gas works where the labour on the sulphur purifiers was very great?—Until tested.

1832. I should not select it by preference?—I think you would be justified in not doing so. When I said 25 grains I was not speaking of crude gas. We have to purify it to that.

1833. I had rather reference to the crude gas?—Unfortunately I could not speak about that.

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1834. (Chairman.) You told us that you had one sample of beer which proved arsenical, in which Bostock's sugar had not entered, and that you attributed the arsenic in that beer to the malt. Can you tell us approximately how much arsenic there was per gallon in that beer?—Approximately it was certainly well under one-twentieth of a grain per gallon. I did not actually estimate it.

1835. But it was readily ascertainable by the Reinsch test?—Yes, applied as I described. Perfectly distinct and unmistakable crystals were obtainable. I have some that I can show you, if you desire.

1836. In the other arsenical beer, which you tested there might have been considerably more than 1-20th of a grain per gallon, might there not?—Yes; they varied up to half a grain.

1837. (Sir William Church.) Had the local malts which you tested been brushed and screened?—I should say they had, from their appearance.

1838. But you are not positive?—They had certainly been screened, because there was no malt dust in them. I think that although screening may rid an arsenical malt of some of its arsenic, I do not think it will ever bring it down sufficiently free to make it safe or judicious to use it.

1838*. After brushing or screening?—That is my opinion.

1839. (Dr. Whitelegge.) Were those malts in the condition in which they were used by the brewer?—What I found was that 1-40th of a grain per pound had been screened. I do not say that it had been brushed.

1840. It was in the state used by the brewer?—Certainly.

1841. So that, taking 2lb. of malt per gallon of beer, it might give rise to 1-20th of a grain per gallon?—I do not think it would all enter into the beer. Arsenious oxide is not a very soluble substance.

1842. (Chairman.) Do you think it might be deposited and carried away in the yeast?—It remains insoluble, either sticking to the grains themselves or filtered away by the grains themselves. I did not do the analyses of the beer and of the malt; that is only a supposition.

1843. (Dr. Whitelegge.) That would rather explain the absence of any arsenic in beer due to the use of malt dried by coke fumes. You said just now, did you not, that much of the arsenic in the malt would disappear without entering permanently into the beer?—I say it is quite possible that some of it would.

1844. But as far as that goes, it would tend to explain the absence of arsenic in beer if prepared from malt dried from coke fumes?—This malt was dried by coke fumes, and that is the reason it became arsenical.

1845. I understood you to draw the conclusion from the general absence of arsenic in the beer samples which you had examined—in your local malts—that the coke fumes could not contain arsenic?—Not to any appreciable extent. But some of the arsenic, surely, would go into the beer from the arsenical malt under local circumstances, the same as if it had been made in Yorkshire.

1846. Then it is the absence of arsenic in the malt and not in the beer, that leads you to the conclusion?—Both; because I did not find any arsenic in any other samples of beer but what go to the use of Bostock's glucoses, with the exception of those I spoke of, and which we found were traceable to one particular arsenical malt. Curiously enough, when they were submitting these samples I always found their bitter beer was free from arsenic, and I thought that these traces of arsenic which I was detecting were due to

contamination by yeast or the vessels from the previous use of glucose. The brewer came to see me, and he said, "Your theory I feel sure is wrong. It is not entirely due to contamination. It is due to malt." I said, "I am very surprised if it is due to malt. I will ask you one question. Do you use the same vessels and the same yeast for your bitter beer?" He said, "Yes." I said, "Your bitter beer is never arsenical." He said, "No, because we never use this particular malt in it." I may say that I never condemned, nor did I ever find any arsenic in their bitter beer; but I was continually finding it in these beers in which there was a portion of the malt, or entirely the malt, from this particular Yorkshire firm.

1847. You could exclude in these cases any idea of dilution of arsenicated beer?—I could not positively prove it personally. This was a very respectable man who came to me.

1848. Are you satisfied that that did not happen?—I am quite satisfied that he was simply acting in his own interests, and trying to find out the mystery.

1849. (Chairman.) Why did he not use that particular malt in the bitter beer?—I cannot tell you the trade reason. I suppose it was not so suitable for that particular class of beer.

1850. Was it known to be of an inferior quality of malt?—It was chiefly foreign malt. I cannot say why he did not use that particular malt.

1851. (Dr. Whitelegge.) Can you tell us from how many brewers the arsenicated samples came?—I should think about 12.

1852. There were about 100 brewers approximately, of whom 30 were home brewers, leaving 70, and out of that 70 there were 12 whose beer contained arsenic; is that so?—I do not know the brewers myself. I took Dr. Reid's report, and he said that the beer samples submitted to me represented so many brewers. I have ascertained from other sources what the other samples represented, and I make out that the 300 samples I tested represented 100 brewers. I find 13 breweries were arsenical.

1853. (Chairman.) Could you give us the names of those brewers?—I will send the names in to the secretary. You will, however, be better able to get that information from Dr. Reid than from myself.

1854. (Dr. Whitelegge.) Among the 300 samples, you mentioned 26 as being arsenical in one group, and 33 as being arsenical in a second group?—That is so.

1855. Deducting those 59, we have 241 approximately in which you found no arsenic?—Yes.

1856. Might there have been arsenic in a small quantity of those, say 1-50th of a grain?—I think I should have suspected if there had been 1-50th of a grain.

1857. If there were any arsenic it must probably have been less than 1-50th of a grain?—Yes; I should say so.

1858. Have any instructions been formulated for public analysts by any authority as to the examination to be made in the case of any article of food, substances to be looked for?—No.

1859. In the years prior to 1900, it was not your own practice or that of public analysts generally to examine beer for arsenic or other deleterious substances, but simply for salt and hop substitutes, is that not so?—We generally looked for them. Those were the chief things.

1860. Those were what you looked for as a matter of routine?—Yes.

1861. No suggestion has been made to you in any official way as to any routine in the examination of beer samples?—No.

1862. Having examined for salt and hop substitutes and salicylic acid, what form did your certificate take if you had no exception to take to the sample?—I simply marked it as "genuine." "I am of opinion that this sample is genuine," and pass it.

1863. Without a statement of what it had been examined for?—Undoubtedly.

1864. Would it be convenient if official instructions were drawn up and issued?—I do not think it would be any help.

1865. Do you think it is better left to each public analyst?—Yes. He might restrict himself entirely to certain tests. Some public analyst might possibly try and shield himself, and say, "I have sought only for judgment."

Mr. E. W. T. Jones.
7 Mar. 1901

Breweries which supplied arsenical beer.

No Central Authority instructs Public Analysts what to look for.

Mr. E. W. T. those things I was instructed to seek for," and he would seek for no more. Now his duty is to seek for everything which he thinks it is desirable to seek for.

7 Mar. 1901.

1866. (Chairman.) Whether for contamination or adulteration?—Yes. If I suspected arsenic, it would undoubtedly be my duty to look for arsenic. I cannot get out of that duty. If there had been any reason for looking for arsenic I should be greatly blamed for not doing so. There is no doubt about that.

1867. (Dr. Whitelegge.) And you propose to continue in the future to look for arsenic?—Yes. I shall take care to do so; but I do not suppose that I shall ever find it again.

1868. What were the impurities which used to be found in beer in former years, and which it would be proper for you to look for?—I used to look for Cocculus Indicus, but I no longer look for it. I used to look for strychnine in the early part of my career, but I do not do so now.

1869. Will the time come when you will no longer look for arsenic?—Not in my time, probably.

1870. Would you say that the method of analysis ought to be left to the individual analyst?—Yes, I think so. There are some processes that one analyst by personal equation cannot work so satisfactorily as another, although he would arrive at the same conclusion. I do not believe in too much dictatorial instruction from headquarters to an officer who is supposed to have some brains.

1871. (Professor Thorpe.) With regard to that particularly bad sample of glucose which you got from Mr. Collingwood Williams, and which contained .05 per cent. of arsenious oxide, have you done anything beyond determining the amount of arsenic in it?—No; I only had a very small quantity. I do not think I had more than about 2 or 3 grammes left after I had weighed out the quantity for the arsenic.

1872. I suppose you did not search for any evidence of selenium?—No, I did not.

Seleni looked

FIFTH DAY.

AT WESTMINSTER PALACE HOTEL.

Wednesday, 13th March, 1901.

PRESENT:

The Right Hon. LORD KELVIN (in the Chair).

The Right Hon. Sir WILLIAM HAET-DYKE,
Sir WILLIAM CHURCH.

Professor THORPE
Dr. WHITELEGGE.

Dr. BUCHANAN, Secretary.

Dr. GEORGE REID, called; and Examined.

Dr. G. Reid. 1873. (Chairman.) I believe you are County Medical Officer of Health for Staffordshire?—Yes.

13 Mar. 1901

Epidemic in
Staffordshire
and action by
County
M.O.H.

1874. Can you tell us anything with regard to the population of Staffordshire?—The estimated population of the geographical county in 1899 amounted to 1,203,485, of which number 296,369 constitute four county boroughs, leaving 907,116 as the population of the administrative county. The administrative county is divided into 57 sanitary districts, of which 38 are urban districts, with a population of 677,968, and 19 are rural districts, with a population of 229,148. There are fifty medical officers of health in the administrative county, seven of whom hold joint districts of two each. The object I had in the inquiry was to arrive as soon as possible at the likely injury which had resulted from the consumption of arsenical beer, and with that object I communicated first of all with the medical officers of health, asking each one to inquire locally of local practitioners, and in addition to that I communicated specially with the members of the medical staffs of the hospitals. There are 14 fairly large hospitals in the county, and the medical staffs of those hospitals comprise 43 physicians. I obtained answers from 44 out of the 48.

1875. (Dr. Whitelegge.) You took precautions to avoid the overlapping of their replies with those of the medical officers of health?—Yes; in every case I took precautions. A very large amount of correspondence followed the receipt of the returns, and I only accepted as cases those about which there could be very little doubt. There were many cases returned as likely cases of poisoning, but I excluded those, partly because of the answers being insufficient, and in many cases after specially communicating with the notifier.

1876. (Chairman.) You asked each local medical officer of health for cases which had occurred in his practice?—Yes; and also cases which he had discovered from inquiry locally among other practitioners.

1877. Would local medical officers of health in private practice have difficulty in some cases in getting information from their brother practitioners?—Not in this case. I think in no instance did they have any difficulty.

1878. (Dr. Whitelegge.) Did you receive lists of cases, or merely total numbers, and locality?—The total numbers, the localities, and the possible source of the contaminated beer.

1879. But not the name and sex and address?—No.

1880. (Sir William Church.) Were many of the cases, or any of the cases, from the private practice of these doctors, or were they all poor-law cases?—A good many of the cases were from private practice, but the majority, as it happens, did not occur amongst the practices of the medical officers of health.

Dr. G.
13 Mar.

1881. (Chairman.) Do you think the numbers given by you may in some cases be understated?—I should think that they are understated rather than overstated.

1882. (Dr. Whitelegge.) Were there many from the poor-law officers?—I did not communicate specially with the poor-law officers, and I did not inquire as to whether these returns were from them or not. I could analyse the returns and give that information, but I could not give it now. These are the returns I have compiled:—

NUMBER AND DISTRIBUTION OF POISONING CASES AND THEIR PROBABLE RELATION TO THE IMPLICATED BREWERIES.

The following table shows the number and distribution of the cases (excluding suspicious cases) together with the probable sources of the arsenical beer up to third week in December, 1900.

DISTRICT.	No. of Cases.	Distinctive No. of Suspected Brewery.
Ambicote (Urban)	5	5*
Elston	4	88
Brownhills	31	47
Cannock	14	47
Cosley	5	1 and 5*
Darlaston	88	59 and 88
Hanley (County Borough)	5	?
Lichfield (Urban)	91	47
Longton	6	?
Newcastle	3	?
Rugeley	8	47
Short Heath	1	?
Stafford	4	47
Stone	09	3 and 5*
Tipton	13	88
Walsall (County Borough)	4	?
Wednesbury (Urban)	4	54
Willenhall	2	?
Blore Heath (Rural)	3	?
Cannock	3	47 and 88
Cheadle	2	?
Eccleshall	6	27 and 5*
Gosall	4	?
Lichfield	290	47
Stone	2	?
	667	

* Arsenic not found, but have reason to suppose that contaminated beers were withdrawn before enquiry.

1883. (Chairman.) I see that in your table you give the total of 667 cases in the county. Do you think the Commission may understand that not less than 667 cases occurred, or that quite possibly there were many more?—Certainly not less; quite possibly more.

1884. Many more?—I should not say many more. As the information came in with regard to the cases I communicated daily with the Inspectors of Food and Drugs under the Sale of Food and Drugs Act, and directed them to take samples, more particularly in the districts in which the cases occurred.

1885. (Dr. Whitelegge.) Who are the inspectors of food and drugs? Are they officers of the County Council?—Yes, they are officers of the County Council. There are two—one for North Staffordshire, and the other for South Staffordshire.

1886. Do they act under your direction?—I advise my committee generally regarding the work under the Food and Drugs Act; but, as a rule, except in special cases, one does not interfere with the Inspectors' work. In this case I did direct them. I do not, as a rule, report direct to the County Council. The inspectors themselves report to the County Council.

1887. (Sir William Church.) What length of time would elapse between your getting samples of beer in this manner and your being able to take action? Would you impound the beer or state that the beer was not fit for food?—About three days, I think, would elapse in most cases between the receipt of the sample by the analyst and the report to me with regard to its being arsenically free or not.

1888. Could you take immediate action against the seller at the end of those three days?—We did not, as a matter of fact. The policy the County Council laid down was that they should not take proceedings against any of the sellers in the first instance.

1889. Had you power to?—We had power to, but we could not have done so without estimating the quantity, and that would have taken longer. We did not trouble very much in the first instance about the quantity of arsenic present, but simply ascertained the fact that it was present in order to follow up the different breweries, and obtain particulars from the brewers.

1890. Would you have had power to seize the beer in the breweries?—Oh, no.

1891. What machinery would you have had to use to get hold of it?—We should have taken proceedings against the seller of the beer, not the brewer.

1892. And those you could have taken immediately?—As soon as it was ascertained that the beer was arsenical—certainly.

1893. Do you say you would have had to wait for the quantitative analysis?—It would have been wise to do so, in order to decide whether it was a case on which to take proceedings or not.

1894. Can you in your district, in the case of any prosecution under the Food and Drugs Act, act within a few days?—Yes; I do not know anything against it.

1895. (Dr. Whitelegge.) That depends upon the date of the analyst's report, does it not?—Certainly; it entirely depends upon that.

1896. (Sir William Church.) What is the length of notice with regard to the taking of proceedings?—I am afraid I cannot tell you what that is; I do not know.

1897. (Dr. Whitelegge.) You mean within two or three days. The analyst being prompt in making his report, you would be able to initiate proceedings?—Certainly. The Clerk of the Council would initiate proceedings.

1898. In what terms did the analyst report in these cases?—Simply with regard to the presence or absence of arsenic.

1899. What did you understand when absence of arsenic was reported?—That he did not find arsenic.

1900. Did you infer that there was no trace of arsenic?—Yes; he reported to me as to whether there was "a trace" or "a considerable quantity."

1901. Then he did not report in the usual terms that the sample was genuine?—No; for this particular inquiry it did not matter to me from that point of view whether it was genuine or not. It was simply a matter of whether it contained arsenic or not, in order that I might be able to follow up the investigation as rapidly as possible.

1902. Then he reported either that arsenic was present, that a trace of arsenic was present, or that there was no arsenic?—Yes.

1903. And where he reported that there was no arsenic you understood that none whatever was present?—Quite so.

1904. Did you give instructions to the analyst as to the method of dealing with those samples?—No, except the general instruction that we did not propose to take proceedings at that stage, and for that reason it was desirable to ascertain qualitatively in the first instance so as to get on as fast as possible with the work.

1905. So that if the analyses had been made on the ordinary lines the analyst would have required a longer time?—Yes.

1906. Was any independent action taken by the local medical officers of health?—In some instances. They communicated with me that certain cases had occurred and that they suspected certain beers. I suggested in certain cases that they should collect samples of those beers and send them to the county analyst.

1907. Have they power to do so under the arrangements made by the County Council?—Yes, they have power to do so. I think there is nothing to prevent their doing so; but, of course, the local authorities have to pay the expenses of the analysis. In this special case that was not done. We undertook to analyse all the samples.

1908. As a matter of ordinary practice, does the administration of the Sale of Food and Drugs Act in the smaller districts rest entirely with the county authorities?—Entirely.

1909. (Chairman.) That is the County Council?—Yes.

1910. A county borough is a borough with a population of over 50,000—is that so?—That is so.

1911. Is that the definition of a county borough?—Yes.

1912. (Dr. Whitelegge.) They must claim county boroughship, must not they?—These boroughs were county boroughs originally by reason of their population. Of course, you may have a borough with a larger population than that, and it need not necessarily be a county borough unless they claim to be so.

1913. (Chairman.) But they can claim?—Yes.

1914. Each county borough appoints its own analyst, independently of the geographical county in which it lies?—Yes.

1915. Has a municipal borough power to appoint its own analyst?—Yes. I do not know whether there is any regulation with regard to the population in that respect—I am not quite sure.

1916. I am told that a municipal borough which has power to appoint its own analyst has a population of 10,000 or over?—Quite so. That is probably it. We have only one example of that in which they have selected to appoint their own analyst.

1917. Where was that?—At Newcastle.

1918. Is that a municipal borough?—Yes.

1919. (Dr. Whitelegge.) Were the whole of the samples taken from the retailers?—Yes.

1920. Have you power to take samples from brewers?—I do not think so.

1921. (Sir William Church.) Supposing you had reason to think that the beer in the breweries was contaminated, under the Public Health Act, could not you take action?—I doubt whether we could. As the result of the analyses, 140 samples of beer having been analysed, 15 were found to be decidedly arsenical, and 7 slightly so. Eleven samples of glucose, brewing and other sugars, were analysed, and two samples of the glucose were found to be arsenical—both of Bostock's manufacture.

1922. (Dr. Whitelegge.) From what source were the samples of glucose obtained?—They were both obtained from brewers. On the occasion of my visits to the various brewers, I obtained a sample from two of them of the glucose they had been using.

1923. That was informal?—Yes, quite informal; they need not have given them to me.

1924. (Chairman.) You visited the implicated breweries, I believe?—Yes, and the brewers very willingly gave me the information I wanted. I believe in most cases they were very active in withdrawing the contaminated beers.

Dr. G. Reid.
13 Mar. 1901.

Samples collected under F. and D. Acts independently of C.C.

Who appoints Public Analyst.

Samples under F. and D. Acts must be taken from retailers

No power to seize arsenical beer in breweries under P. H. Acts.

Informal samples obtained from Brewers.

Dr. G. Reid.

13 Mar. 1901.

Arsenical
beer re-
mained un-
destroyed for
the purposes
of rebate.

1925. Is there anywhere in Staffordshire a brewery where Bostock-brewed beer remains on the premises at the present moment?—Up till lately a quantity of beer did remain on the premises at least in one case, but I don't know whether at the present moment there is any. The reason was that the beer was retained in the hope of getting the duty refunded.

1926. And in the meantime they kept it on the premises?—Yes, or it was locked up in their public-houses.

1927. (Professor Thorpe.) Why was it necessary to keep it for the purpose of obtaining a draw-back?—It was only kept, I suppose, in order that they might be able to establish the fact that a certain quantity had not been sold.

1928. But is there anything exceptional in that particular case. Why should the brewer not have called in the Revenue officer to measure the quantity and then proceed to destroy it?—The Revenue officer could not always come when he was called in; they had to wait for him to come.

1929. It was not because of any reluctance on the part of the brewer to destroy the beer, but because the official was not able to attend at the time?—That is so.

1930. (Chairman.) Was there any delay on the part of the Inland Revenue authorities in intimating whether or not the duty which had been paid would be refunded?—I believe so. I do not know whether they have intimated so even now. Quite lately they had not done so.

1931. Is not that unfortunate?—I think it is distinctly unfortunate.

1932. Did the brewers without exception afford you every information?—They did.

1933. Have you any further remarks to make with regard to it?—I should like to point out that in one instance this delay on the part of the Inland Revenue led to arsenical beer being sold, although it had been withdrawn by the brewer, the public-house keeper himself selling beer which had been condemned. If the brewer had had an intimation from the Inland Revenue Office that the duty would be refunded, he would immediately have destroyed that beer, and that could not have happened.

1934. Was this accidental on the part of the seller?—No, it was deliberate.

1935. (Professor Thorpe.) Why is it that you so confidently say that, if the Inland Revenue Office had expressed its willingness to pay the rebate, the beer would have been destroyed?—The brewers have told me that they were quite prepared to destroy the beer, but at the same time they did not want to lose more than was necessary, and as they could not get the duty refunded without proving the quantities destroyed, they had to wait until the Inland Revenue authorities satisfied themselves regarding that point.

1936. Inasmuch as the beer would have had to be destroyed sooner or later, I do not quite see why that necessarily caused the beer seller to put the beer back for consumption?—The reason why the beer seller put it back for consumption was because he was merely the tenant of a tied house, and by selling this beer he obtained profit from it which he otherwise would not have obtained; that it to say, the money obtained from the sale of this beer went entirely into his pocket.

1937. He was a seller in a tied house?—Quite so.

1938. Then he was not a free agent?—He had the instructions of the brewer not to sell this beer, and in the face of those instructions he sold it.

Prosecution
under F. and
D. Acts in
Shropshire.

1939. (Chairman.) Was action taken against him?—Yes, action was taken under the Sale of Food and Drugs Act; not by the Staffordshire County Council.

1940. What was the penalty for that?—I do not know what the penalty was in this case. It would be a fine.

1941. (Dr. Whitelegge.) Do you know under what section the prosecution was taken?—No; it was in Shropshire this occurred.

1942. In cases where there was delay on the part of the brewer, and on the part of other persons, in destroying contaminated beer, were the local medical officers of health informed?—I do not think there was any delay on the part of any brewer in withdrawing arsenical beer; one did not find there was any delay.

1943. In the case of the brewer who retained the arsenical beer under lock and key, as I understand, pending the decision of the Inland Revenue authorities or a

visit from their officer?—Several brewers did so, but the respective medical officers of health were not specially informed of that fact.

Dr. G.
13 Mar.

1944. And in the case of the retailer, was the action taken by the local authority, so that the medical officer of health was aware without any intimation from your self?—Yes, in that case.

1945. Were the local medical officers of health informed which were the arsenical breweries?—Not specially, but I was in constant communication with them, and I think in every instance they did get the information.

1946. (Chairman.) Will you describe the results of the analyses?—Out of the 140 samples analysed 15 were found to be decidedly arsenical, and 7 very slightly so. Quantities of arsenic in the Staffordshire beers

1947. (Dr. Whitelegge.) What do you mean by slightly so?—Under 1-20th of a grain per gallon. Eleven samples of glucose, brewing and other sugars were analysed, and two of the glucoses were found to be arsenical.

1948. (Chairman.) Were the eleven samples of glucose obtained from different manufacturers?—No, the two samples that were found to be arsenical were from the same manufacturer.

1949. Were some of the other samples from other manufacturers, or were all the eleven from different manufacturers?—They were all from different manufacturers, with those three exceptions. But they were not all glucoses.

1950. Glucose and brewing and other sugars?—Yes.

1951. There were only two samples of glucose or other brewing sugar from Bostock's?—That is so.

1952. And they were both found arsenical?—Yes.

1953. And there were nine samples from other manufacturers none of which were found to be arsenical?—That is so.

1954. What was the amount of arsenic found?—The amount of arsenic found in contaminated beers varied from "a trace," under 1-20th of a grain per gallon, to a little over half a grain. The 140 samples were collected from 28 different districts, and 140 distinct sources. They represented the beers of 90 brewers, including 26 samples of home-brewed beer.

1955. (Sir William Church.) That means the beer used by a publichouse where the publican brews his own beer?—That is so.

1956. Not a beer brewed by private individuals?—No. In only one instance did we fail to trace the contamination of the beer to the use of Bostock's glucose. Arsenical beer all to contain Bostock's sugar.

1957. What brewery was that?—That was a brewery at Newport, in Shropshire.

1958. Did you succeed in finding the cause of the contamination?—No. I visited the brewery, and the brewer admitted having used Bostock's sugar, or having had Bostock's sugar on the premises 12 months previously, but he assured me that no glucose from Bostock's had been used within 12 months. Of course, it is just possible that it may have been, but if what he told me was correct, I cannot say how the arsenic got into that beer.

1959. (Dr. Whitelegge.) Was any examination made of the malt?—No, not in that case.

1960. (Professor Thorpe.) What were the materials used in the brewing?—He used glucose in brewing, and he told me what glucose he had been in the habit of using subsequent to Bostock's.

1961. What glucose was that?—He used two glucoses, one from Garton, Hill, and Co., and the other from Valentine, Todd, and Co.

1962. Do you know if those firms are actual makers of this material?—I believe Garton, Hill, and Co. are not makers.

1963. You know nothing about the other one?—No.

1964. What was the amount of arsenic found in that particular beer?—It was not estimated.

1965. Was it more than "a trace"?—It was returned as "distinctly arsenical," but the amount was not estimated.

1966. (Chairman.) And the origin in that case was not known?—It was not known. I should like to mention in connection with that case that the house where the beer was obtained was not a tied house, and although the publican said that the beer was obtained from this particular brewery it does not follow that it was so; it may have come from some other source.

G. Reid. 1967. (Professor Thorpe.) It may have been brewed from Bostock's sugar?—It may have been. The only reason I had for saying that it was not brewed from Bostock's glucose was the assurance I had that the beer was obtained from the particular brewery in question; but there is just the possibility of its having been obtained from another brewery, because it was not a tied house. The publican said he did not obtain beer from any other brewery than the one I specified.

1968. (Chairman.) The Commission would like to have the names of the breweries referred to by the numbers in your statement?—I will supply them.

1969. In the table in your statement you give 667 cases. Is it probable that the numbers are under-estimated?—Yes, that is so.

1970. In many of the returns suspicious cases were not mentioned?—No, they were not.

1971. And many of those suspicious cases may have proved real?—They may have done so.

1972. Which were not included in this number?—That is so.

1973. How many fatal cases were there?—I believe it is possible there may have been two deaths.

1974. Two deaths out of the 667?—Yes.

1975. The 667 were all decidedly cases of illness?—There is no doubt about that.

1976. Severe illness?—Some cases were severe and some were slight.

1977. And all due to arsenic?—Yes.

1978. (Dr. Whitelegge.) To what causes were the fatal cases attributed?—Arsenical neuritis was said to be the cause in one, and in the other it was not returned as arsenical neuritis, but I had reason to suppose from a conversation with the practitioner that there was extreme probability of its having been so.

1979. What cause did he assign in the certificate?—I cannot tell you.

1980. Were there any cases of illness in Wolverhampton? I do not see Wolverhampton mentioned in your list?—I got returns from Wolverhampton, but they were all in the negative.

1981. So that, as far as your knowledge goes, there were no cases in Wolverhampton of arsenical poisoning?—As far as my knowledge goes. I may say with reference to that that later on I believe cases that were supposed at the time of my enquiry not to have been arsenical poisoning were found to have been so.

1982. So that those also would need to be added to the list to make it complete for the geographical county?—Quite so; but that I have no real evidence of.

1983. (Chairman.) Many of those cases were reported as arsenical neuritis?—Yes.

1984. That is a new name, not known before the recent scare, is it not?—That is so.

1985. Is it likely that there may not have been mistakes, the thing being so new?—I do not think so.

1986. Mistakes in calling it arsenical neuritis?—I do not think so.

1987. Many different practitioners made the returns?—Yes; I cannot tell you how many practitioners made the returns to the medical officers of health locally; but I had returns from all the medical officers of health, namely, 54, that is, 50 in the administrative county and the four medical officers of health of county boroughs, and 44 out of 48 hospital physicians.

1988. Do you think all of them had sufficient knowledge of the symptoms to be able to declare that it was arsenical neuritis?—Yes, especially in view of the prominence given to the question in the medical journals.

1989. (Sir William Church.) I suppose we may take it that many of the cases of illness which have been returned lately as arsenical neuritis would have been returned a year ago as alcoholic neuritis?—Yes, probably, or not recognised one way or the other—very mild cases.

1990. We have had evidence before us of what was called alcoholic neuritis being a very prevalent condition in Manchester and Liverpool for some time. Do you know whether that was the case round Lichfield, for instance?—I have no information with regard to that.

1991. Nor in any part of the county?—I have discussed the question with some members of the staffs of

the two large hospitals, namely, in the north and south of Staffordshire.

1992. Lichfield and Bilston seem to be the places where the greatest number occurred?—But there were no hospitals there; those cases were reported by private practitioners.

1993. (Chairman.) In your table you gave a number of cases for each district, and the suspected brewers or breweries. Are we to understand that the beer of those breweries, or some sample of beer from those breweries, was found arsenicated in every instance except those referred to by the asterisks?—That is so. I think there can be no question that brewery No. 5 had at one time brewed arsenical beer, because cases followed that particular beer throughout all parts of the county; but we never succeeded in obtaining a sample which on analysis proved to be arsenical.

1994. (Sir William Church.) Was No. 5 the brewery which had ceased to use Bostock's during the year?—No; that is not the same brewery. This No. 5 brewery, I think, must have been using Bostock's glucose; at any rate, I feel satisfied that it had been brewing arsenical beer, and had withdrawn all the beer very actively before we started the inquiry.

1995. (Chairman.) No. 5 is the only brewery to which the asterisk applies?—Yes.

1996. In every one of the others connected with the cases beer was found arsenical?—That is so, except where there is a query.

1997. A query, and no name mentioned?—Yes.

1998. But in every case of a number mentioned arsenic was found in the beer in that brewery?—Yes, that is so.

1999. (Sir William Church.) How do you explain the freedom, or comparative freedom, of Stafford itself? I see only four cases are marked in Stafford?—It so happens that the breweries supplying Stafford were not implicated breweries. The four cases in Stafford were connected with an implicated brewery in Lichfield, that is to say, it was the Lichfield beer.

2000. Stone rural appears to have very few cases as compared with Stone urban?—The reason of that, I think, would have been probably explained had we found arsenic in the beer of brewery No. 5, which has a large sale in the urban district of Stone. We did find an arsenical beer brewed by another brewer in Stone, only the quantity of glucose used was not sufficient, from the experience in other districts, to have caused the illness there, and that is my reason, together with the fact that cases were dotted about all over the county connected with No. 5 brewery, for saying that I feel certain that No. 5 brewery at one time contained strongly arsenical beer.

2001. Many of those cases in the rural districts were in houses connected with No. 5 brewery, tied houses, perhaps?—I do not say in the rural districts particularly.

2002. (Chairman.) Which is Stone rural and which is Stone urban in your list?—The urban is the first one.

2003. Stone urban, 60?—Yes.

2004. Breweries 3 and 5?—Yes; and Stone rural is 2.

2005. (Sir William Church.) Would the houses in the rural districts be generally free or tied?—I think they are just as likely to be tied in the rural districts as in the urban.

2006. (Professor Thorpe.) What is the relative proportion between Stone rural and Stone urban as regards population?—The rural has about twice the population of the urban.

2007. (Dr. Whitelegge.) To what period do these figures relate?—Up to the close of the first stage of the enquiry—that would be the end of the third week in December.

2008. Have you more recent figures?—I have more recent returns, which I mention under the head of "Further Inquiry." "After an interval of about four weeks circulars were addressed to most of the medical practitioners who had previously reported cases, and from the replies received it would appear that 60 of the original patients are still suffering from the symptoms. A few fresh cases are also reported by two medical practitioners, but from subsequent inquiry I am by no means satisfied that the cases were of recent origin."

2009. Was there any observable increase of neuritis in the death returns recently, to your knowledge?—

Dr. G. Reid.
13 Mar. 1901.

Breweries implicated in Staffordshire.

Local distribution of cases

Other cases since December 1900.

Dr. G. Reid. Not to my knowledge; of course, I have not got the recent death returns, and in the reports sent to the County Council annually, by medical officers of health, the causes of deaths are frequently not fully classified.

2010. (*Chairman.*) I see in the part of your précis which follows the table reference to "another and largely implicated brewery." Was this brewery in the Potteries district?—Yes. Perhaps I may refer to that paragraph more particularly, because it is rather instructive with regard to the quantity of arsenic which gave rise to the symptoms. "One remarkable, and, from a clinical point of view, instructive fact, has been demonstrated by the inquiry in Staffordshire, namely, that whereas at least 67 per cent. of the cases were attributable to one implicated brewery, another and larger implicated brewery, supplying a much larger population, did not give rise to recognisable cases of illness calling for medical treatment. In the first case the quantity of arsenic per gallon of beer was found to be a little over half a grain, while in the latter case only 1-10th of a grain was found. In both cases it so happens that the quantity of glucose used to malt was 20 per cent., and the amount per gallon 5·1 and 5·6 ounces respectively, but, whereas in the former case one glucose only (Bostock's) was used, in the latter the brewer used a mixture of equal parts of three different glucoses, only one of which was Bostock's; thus, while the actual quantity of glucose used was very much the same in both cases, the relative proportion of arsenical glucose per gallon of beer was 5·1 and 1·8 ounces respectively, a proportion which is consistent with the quantity of arsenic found in the two beers. As it would appear, then, that thousands of persons, for an unknown period, had been drinking beer containing 1-10th of a grain of arsenic per gallon without suffering any effects sufficient to call for medical attendance, the question arises is this the first occasion on which arsenical beer has been brewed, and may not some illness have previously occurred which, in view of what we now know, may have been attributable to arsenical poisoning?"

2011. 67 per cent. of the cases, I see, were attributed to one brewery?—Yes; that brewery was at Lichfield, and was, no doubt, largely responsible for the cases in Lichfield urban and rural districts, and in Brownhills, and Cannock.

2012. (*Sir William Church.*) What is its number?—47.

Cases in Lichfield and neighbourhood. 2013. (*Chairman.*) I see there were 250 cases in the Lichfield district?—Yes, in the rural district. But in that and the adjoining districts which one may say are largely supplied with beer from that particular brewery, there were 434 cases.

2014. 434 cases in all supplied from No. 47 brewery?—Probably supplied. Of course, one cannot absolutely say. I have one or two figures which amplify the information I have given in that particular paragraph, which perhaps I may call your attention to. I have a shaded map (Appendix 7) here showing the actual districts. For example, in North Staffordshire the towns of Burslem, Hanley, Newcastle, Stoke, Fenton and Longton having a total population of about 220,000, there is a very large brewery supplying a great number of houses in that particular locality, and that beer was found to be arsenical.

2015. Largely arsenical?—About one-tenth of a grain per gallon.

2016. (*Dr. Whitelegge.*) What is the number of that brewery?—That is No. 6.

2017. No. 6 is the brewery that had the largest quantity of arsenic found per gallon?—No; brewery 47 had the largest quantity. We had only fourteen cases reported in that population of 220,000; whereas in the Lichfield district, including Lichfield urban and rural, Brownhills, Cannock, and Rugeley, there were 434 cases reported, although the population is only about 72,000. I do not know whether you follow me. The population in the case of the northern towns supplied by arsenical beer containing one-tenth of a grain per gallon is 220,000; the population in the southern districts supplied largely by beer containing half-a-grain per gallon is 72,000. In the former case we only had fourteen cases, and in the latter 434 cases. That is to say for every case that occurred in the larger area, 31 cases occurred in the smaller area.

2018. (*Chairman.*) Out of the whole 667, 434 were attributed to beer, which in certain samples taken at

the end of last year was found to have half a grain of arsenic per gallon?—That is so. The case rate in the northern towns was '06 per thousand, associated with 1-10th of a grain per gallon of arsenic, and in the southern districts 6 per thousand.

2019-20. (*Chairman.*) I understand you to say that is 6 per thousand associated with half a grain per gallon?—Yes. The '06 per thousand refers to the 1-10th of a grain per gallon.

2021. (*Dr. Whitelegge.*) May we assume that the consumption of beer was approximately equal in each case per head?—That I cannot tell. I think, however, you may assume that, because the cases are mostly in the working-class population.

2022. Do you attach any importance to local conditions in either place?—I do not think so.

2023-4. (*Dr. Whitelegge.*) In the northern districts do we understand that the brewery which you have in mind supplied the greater part of the beer?—A very large part.

2025. The conditions were comparable in that way?—Certainly, broadly so they were.

2026-8. (*Professor Thorpe.*) Do you know whether that brewery which supplied mainly the North Staffordshire district, the beer containing 1-10th of a grain per gallon, supplies also other outlying districts?—Yes, it does.

2029. Largely?—Not nearly so largely as in the case of the North Staffordshire districts.

2030. (*Sir William Church.*) Is No. 6 Brewery among those in the list which are stated as suspected?—No, it is not. I did not feel justified in positively associating the small number of cases with that particular brewery. The omission is not a mistake. If I were to refer to the returns from the particular districts in that group in North Staffordshire I should probably find that there was not sufficient evidence in them to justify me in definitely crediting that particular brewery with the cases.

2031. (*Dr. Whitelegge.*) You mean no clinical evidence?—No clinical evidence.

2032. But the beer definitely contained arsenic?—Undoubtedly; and there is a very large sale for the beer from that particular brewery in that locality; but I do not think I had sufficient evidence in the returns to warrant one in attributing the cases to any particular brewery.

2033. (*Professor Thorpe.*) Did you learn that that firm used Bostock's sugar?—Yes. I know the exact proportions in which they did use that sugar.

2034. They used in addition other sugars, did they not?—They did; two other sugars. They are given in my notes. The quantity of glucose used in the case of the southern brewery with which the 434 cases are associated was 20 per cent.

2035. (*Chairman.*) 20 per cent. in the gallon?—No; Bostock 20 per cent. of glucose to malt, and the amount per gallon was 5·1 and 5·6 ounces respectively. That is to say, in the case of the northern towns 5·6, and in the southern towns 5·1. But in the case of the northern towns only one-third of that was Bostock's, whereas in the southern towns the whole of it was Bostock's. That being the case, the quantity of arsenical glucose used in the case of the southern towns was 5·1, and in the northern towns 1·8 ounces. And that is pretty consistent with the relative quantity of arsenic found in the two beers. It follows, therefore, that thousands of persons had been drinking beer for an unknown period containing 1-10th of a grain of arsenic per gallon without suffering any effects sufficient to call for medical attendance.

2036. You say "unknown." Have you any reason to believe it is limited to a certain time?—No. I should say mild cases might have been going on for a long period unrecognised.

2037. But the only special reason to suspect that there had been as much as 1-10th of a grain of arsenic per gallon for a considerable period is the fact that the brewery used Bostock glucose?—That amount was actually found in the beer in question at the end of last year.

2038. But it was traceable to the Bostock glucose?—Yes.

2039. Does any question arise with respect to that?—The question which arises is this: This is the first occasion on which arsenical beer has been proved to have been brewed and to have been the cause of illness. May not

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Dr. Reid. some illnesses have previously occurred which, in view of what we now know, ought to have been attributed to ar. 1901. arsenical poisoning?

2040. You put that as a question. Have you any view yourself? Can you contribute anything towards answering it?—Here is actually what has happened. For a certain length of time beer containing arsenic to that extent, 1-10th grain per gallon, has been consumed in large quantities by a large number of people, and until the recent scare it never has been noticed that any unusual illness occurred. But attention being directed to the matter, cases were recognised which probably would previously have been overlooked. It is quite possible that slight illnesses owing to arsenic may have been going on indefinitely.

2041. (Sir William Church.) Could you give us the returns from the figures of the Registrar of Deaths, showing the number of deaths attributed to alcoholic paralysis during the last five or ten years in the northern district?—I am afraid I could not; but I might obtain the figures.

2042. It would be very interesting to see them?—I could obtain them from the local medical officers of Health, but perhaps some of them would not have sufficient data. You can get them from the Registrar-General.

2043. Of course, it would be a very inaccurate return, but it would be useful and interesting?—I am afraid in some cases you would not be able to get satisfactory returns.

2044. Not from the death certificates?—You could get returns for an area corresponding with this area very closely from the Registrar-General's returns.

2045. But take the northern district, the one in which the attacks have been so few; could you not get it by an application to the Poor Law officers who attend the large workhouses and infirmaries?—You could get it from the workhouses, certainly.

2046. That would be of great interest and of a certain amount of value as bearing upon the increase of deaths attributed to alcoholic paralysis?—Yes; but you can get the actual figures from the Registrar-General's returns for an area corresponding very closely to the area under consideration.

2047. (Chairman.) Would that return show peripheral neuritis and alcoholic paralysis separately?—No; I should say they would be grouped under the same head.

2048. Did the ordinary peripheral neuritis occur in returns as a cause of death or of severe illness previous to this scare?

(Sir William Church.) Peripheral neuritis will occur, I think, under the Registrar-General's returns only since the year 1886. Under the head of peripheral neuritis are certain sub-heads, such as alcoholic, diphtheritic, and so on.

2049. (Chairman.) Then with regard to further inquiries, what course was adopted?—After an interval of about four weeks another systematic collection of samples was undertaken.

2050. (Dr. Whitelegge.) At what date?—At the end of the third week in January, and attention was specially directed to the public houses supplied by the previously implicated breweries, and as a result of this second collection, including 43 samples of beer, 10 of confectionery, and 5 of syrup, all were found to be arsenic free.

2051. (Chairman.) Do you know any case of confectionery or golden syrup that was found to be arsenical?—I do not know of any.

2052. At this recent inquiry you say not, but was there any at any previous inquiry?—No; we have not found any to be arsenical.

2053. (Dr. Whitelegge.) All were found to be free from arsenic, on the same understanding that you explained to us before?—Quite so.

2054. You understood that they were entirely free from arsenic?—Yes, I should say so—that no arsenic could be found; that is to say, analytically.

2055. No trace?—No trace.

2056. (Professor Thorpe.) You mean that the analyst so reported?—Yes.

2057. (Dr. Whitelegge.) In those terms?—Yes, in those terms. The terms were "Arsenic free."

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2058. (Sir William Hart-Dyke.) Were those samples of confectionery you refer to taken from a large area, or were they taken from one town?—They were not taken from one town. I can give you the exact towns they were taken from, if you wish. They were taken from six different districts in North Staffordshire.

2059. They were taken from a sufficiently large area, at all events, to be a real test as to the likelihood or danger of finding arsenic in confectionery?—I should not say it is a real test, but it is a very fair test.

2060. A fair test so far as that portion of the inquiry is concerned?—Yes. The collection of these samples will be continued for some time.

2061. (Professor Thorpe.) I suppose you have not been able to trace the manufacturer of this confectionery as in the case of the glucose, have you?—One could trace the manufacturer, of course.

2062. Would the retailers of the confectionery be able to tell you the wholesale houses with whom they dealt?—I do not know. If any of these samples had been found to be arsenical we should have followed them up, and ascertained those points, if possible; but as they were free from arsenic no further notice was taken.

2063. It might happen that in such districts as you are speaking of there are comparatively few manufacturers engaged in supplying them?—Quite so.

2064. Is any confectionery made in the district?—In one district, I believe—in Newcastle.

2065. Is it a large works?—No; quite a small works.

2066. (Chairman.) At our last meeting Mr. Jones, Meaning of the Staffordshire public analyst, who has tested these "Arsenic-free" beer, samples, told us that he used the test of the Brewers' Expert Committee, which would detect 1-20th of a grain per gallon, and which might in his own hands, or very carefully worked, detect 1-36th of a grain per gallon. Do you understand that "arsenic free" means that the substance does not contain as much as 1-20th?—My information from the analyst is that it is well under 1-20th.

2067. Might it contain as much as 1-36th of a grain per gallon, and be returned as "arsenic free"?—I should say not.

2068. You think it is not as much as 1-36th—that is a good deal less than 1-20th. You think that even as small a quantity as 1-36th could be detected?—I am not prepared to say what quantity could be detected. In the returns the county analyst sent me in some cases the term used was "a mere trace." I do not exactly know what he would mean by "a mere trace"; but I should take it to be well under 1-20th.

2069. 1-36th would be "a trace," at least?—I do not know whether he gave you any information with regard to that. I should not like to say what chemically would be considered "a trace."

2070. When he returned a substance as "arsenic free," he had to ascertain that it contained less than 1-36th?—Yes; I should say so, from what you have told me.

2071. Perhaps it might have contained 1-50th, and be returned "arsenic free"?—I cannot tell you that.

2072. You are not quite sure about that?—No.

2073. (Dr. Whitelegge.) If an analyst told you that a sample of beer contained 1-50th or one 1-40th of a grain, in what light would you regard it—as harmless?—Of course, it depends upon the quantity consumed. In some cases the people drink a gallon of beer a day, or more.

2074. If it contained 1-20th of a grain, I understand you would regard it as dangerous, and you would take certain action in the way of stopping the supply?—Yes.

2075. And if it contained 1-50th or 1-40th, would Administrative you take any action?—I should be in rather a difficulty as regards advising the Council upon that point. Of course, one would like to be in a position to say that beer shall not contain any arsenic. If it is impossible that beer shall be arsenic free absolutely, it is desirable to arrive at some sort of standard, but what that standard shall be I should not like to say at the present moment.

2076. (Chairman.) As a medical question, do you think that a person might take 1-50th of a grain of arsenic per day in food or drink without being injured? 1-100th of a grain, I believe, is a common dose in medical treatment?—Yes, probably.

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Dr. G. Reid. 2077. That might be given two or three times a day?—I do not think it is desirable that anyone should take any quantity of arsenic, even that quantity, regularly.

Effect of small quantities of arsenic in beer.

2078. Would you regard 1-50th of a grain per gallon per day taken unknown in food, and from day to day, as dangerous to health?—I would not say it was dangerous to health. The probability is that you would not find any symptoms from it.

2079. Not if even a dose of that amount were continued from day to day for weeks or months?—I should doubt whether any symptoms would be produced. It is a very difficult question to answer.

2080. (*Professor Thorpe.*) I suppose you are guided to that opinion by what you have told us as regards the comparative infrequency of any cases arising in the North Staffordshire towns where the beer has had as large a quantity as 1-10th of a grain?—One does not know to what extent individuals may have partially suffered without realising that there was much the matter. Some cases have come before medical men, and they must have been suffering, but it does not follow that others may not have suffered in milder degree and gone on suffering without seeking medical advice.

2081. There is a great difference between one-tenth and one-fiftieth of a grain?—Yes, and there is a great difference between one-tenth of a grain and half a grain.

2082. (*Dr. Whitelegge.*) But the 1-20th of a grain has now ceased, has it not? There is no more beer containing 1-10th?—No; it would seem that there is not.

2083. But if it had continued indefinitely you might have anticipated further mischief?—Certainly. I think probably it did cause mischief, more than we know of, only not sufficient in the absence of any suspicion to direct attention to it.

Illness of brewery hands.

2084. (*Chairman.*) Do you think many of the patients drank as much as a gallon a day? You have returns of the quantities admitted to have been drunk?—In some cases.

2085. In some cases there was as much as a gallon a day consumed?—Yes, especially among the brewers' assistants, and in the case of two breweries almost without exception all these assistants were ill.

2086. (*Sir William Church.*) Whom do you mean by brewers' assistants?—Carters, and other people of that sort.

2087. You mean workmen, employees?—Yes.

2088. (*Chairman.*) With that quantity of liquid 1-50th of a grain per gallon, or its equivalent in Fowler's solution, would be detrimental?—Really, I am afraid I cannot say whether it would or not; it is a matter of experience.

2089. A great quantity of liquid would carry it off unabsorbed?—Possibly to some extent.

Minute quantities of arsenic in beer undesirable.

2090. Still, it is clearly a danger to have beer containing 1-50th of a grain per gallon?—It is certainly distinctly undesirable.

2091. Another sample of the beer is suspected as having caused a recent case of illness, is it not?—Yes; this was forwarded to me by a District Medical Officer of Health in consequence of a suspicious case of illness, arsenical poisoning, having occurred where this beer was being drunk, and the result of the analysis was that it contained an appreciable, though not a large, amount of arsenic. Further enquiries showed that this beer had been purchased in October, and that the retailer, the seller, obtained it from one of the brewers who was originally implicated. So it was traced back to the original trouble, and was not of recent origin.

2092. (*Sir William Church.*) You have no idea what an "appreciable amount" means?—No. I do not know; it is the county analyst's expression.

2093. Is this the same county analyst who used the term "a trace"?—Yes.

2094. An "appreciable quantity" would mean "a trace"?—I do not believe it would be much more than "a trace," but certainly not a large quantity, or anything like it.

2095. (*Professor Thorpe.*) Inasmuch as the analyst himself used it, I may point out that he would use it in a technical sense. "A trace" is an amount which the balance could not detect; by an "appreciable amount" it meant a quantity which the balance will detect?—I do not know whether we may conclude that that was so in this case.

2096. Therefore it would be something larger than 1-20th of a grain?—That I cannot say. If the word

"appreciable" is used in that sense it probably would be so.

(*Professor Thorpe.*) It would be something larger than 1-20 grain.

2097. (*Chairman.*) If you desired to measure the amount, the large quantity of liquid in which it was suspended would be evaporated away?—I believe so.

2098. So it is only a relative term, after all? If it is there at all it is appreciable by taking a sufficiently large quantity of the substance?—Yes, I suppose so.

2099. (*Professor Thorpe.*) But in so far that all these were made, as we have been informed, by the method described by the expert, they were all made on the same comparative amount; that is to say, the actual amount of beer taken in each case would be the same?—I do not know what method Mr. Jones adopts at all.

2100. These are samples taken under the Sale of Food and Drugs Act, I suppose?—No; this particular sample was sent to me by a Medical Officer of Health, who obtained it from the attendant on the patient. The sample was sent to me, and as it appeared the case was associated with the beer, I sent it to the County Analyst for his report upon it.

2101. You had the sample?—Yes, I had it; but it was only 24 ounces.

2102. So you know the quantity which was used?—Yes.

(*Professor Thorpe.*) The amount was evidently so small that the analyst could not do very much with it.

2103. (*Dr. Whitelegge.*) Will you tell us about the circulars that were sent to medical practitioners?—Circulars have also been addressed in the second enquiry to most of the medical practitioners who had previously reported cases, and from the replies received, it appears that 60 of the original patients are still suffering from symptoms. A few fresh cases are also reported by two medical practitioners, but from subsequent inquiry I am by no means satisfied that the cases were of recent origin. With reference to that last remark, I inquired especially into these new cases, and I found that they would not have been recognised as cases at all had the patients not consulted a medical attendant for some other ailment, and in the course of that consultation symptoms were discovered pointing to arsenical poisoning. But it is by no means certain when these symptoms made their appearance.

Later enquiry by M.O.H.

Duration of illness

2104. Do you think that the mischief is at an end now?—Yes, I think so.

2105. Do you intend to make any further inquiry with regard to the cases?—I do not think of doing so at present, at any rate.

2106. You do not think that there is anything to be learned?—I think not.

2107. If any inquiry were made, would it, in the light of your experience, be more proper to address it to the Medical Officer of Health or the practitioner?—I should address it, I think, to the Medical Officers of Health, because they took the thing up actively, and inquired from local practitioners. If I addressed it to the medical practitioners, I think I should get fewer returns. I got very full returns indeed. In some cases the local Medical Officers of Health drew up special circulars and circulated them throughout their own districts. I had very full returns from the districts by doing it in that way. Of course, there would not be the same urgency in another inquiry, and it might be well to communicate direct with medical practitioners. But in this case time was of importance. We wanted to arrive at the facts as soon as possible, and we thought the quickest way would be to communicate with the medical officers, and not with individual practitioners, except in the case of hospital staffs.

2108. By hospital staffs I suppose you include the staffs of workhouses and infirmaries?—Yes.

2109. (*Chairman.*) Can you give the Commission any suggestions with reference to preventive measures?—I have given three suggestions. First of all, I think no glucose or invert sugar should be manufactured with sulphuric acid unless the acid has been made from sulphur, and is free from arsenic. Further, that the brewers should obtain a guarantee to that effect from the sugar manufacturer with each consignment.

Glucose should be made from brimstone acid.

2110. Do you not think that sulphur acid guaranteed freed or free from arsenic might be allowed even if it was made from pyrites?—I do not think so.

2111. You think the guarantee of purity would not be sufficient?—No, I do not think so. That would involve the risk of its not having been purified.

2112. (*Dr. Whitelegge.*) Would you suggest any guarantee from the brewer to the seller?—I think that would be a desirable thing as well.

2113. (*Chairman.*) You would not impose any conditions against the use of glucose, except what you would impose upon all the ingredients—that is to say, that they should be arsenic free?—That is so.

2114. Have you any information as to the malt itself being arsenical?—I know that samples of malt have been found to be arsenical, but I have not sufficient information upon the subject to be able to give any evidence with regard to it.

2115. But you think the brewers should be obliged either to test themselves, or to take means of being quite sure that the ingredients they put into the brew should all be arsenic free?—Yes, I think so.

2116. Do you think brewers, besides having a guarantee from the persons who supplied the material, should themselves also make tests?—I hardly think that would be practicable—I mean in the case of very small brewers. The number of packages of the article received would be so great that it would involve a considerable amount of analytical work, and I do not think the small brewers would be able to do that.

2117. (*Sir William Hart-Dyke.*) As not possessing each their own analyst; is that your point?—Yes.

2118. (*Chairman.*) You think that the Inland Revenue Department could help?—I think that the Inland Revenue Department should be called upon to exercise control over brewing materials by its being made part of the routine duty of the Excise Officers to see that the guarantees are obtained, and to periodically collect samples for analysis by the Somerset House officials. That, I think, would be a very valuable addition to the precautions. It would not necessitate the multiplication of inspectors; and, as these officers have to be there in any case, and as the department has the necessary machinery available, it would be a very simple plan to adopt.

2119. (*Dr. Whitelegge.*) So far as power is concerned; but I suppose you would regard it as more or less an accident that the recent mischief has been in connection with beer, and not in connection with other food products into the composition of which glucose enters?—Yes.

2120. The precaution you suggest on the part of the Inland Revenue would only apply to brewers?—Yes.

2121. (*Chairman.*) Does the Inland Revenue Department take charge of the hops used?—There is no reason why they should not.

2122. At the present time do they do so?—I am not aware what they do—I do not think they do.

2123. You say that the brewers should obtain a guarantee from the sugar manufacturer to the effect that it is arsenic free: you would not limit that to the sugar maker alone; would you not have a guarantee from the maltster?—That might be desirable as well.

2124. And from the purveyor of hops?—Yes; I would make it apply to brewing materials.

2125. In connection with the sanitary authorities under the Sale of Food and Drugs Act, have you any suggestions to make?—The only suggestion that I have to make is that I think it would be desirable that the Food and Drugs inspectors should have additional powers enabling them to seize contaminated beer.

2126. (*Dr. Whitelegge.*) Your inspectors?—Yes.

2127. Not the inspectors of the local authorities?—No. It depends upon how the Act is worked in the county. In some cases there is a considerable amount of work done by the local authorities in that direction, but in Staffordshire, at any rate, it is done practically entirely by the County Council.

2128. You would say that any inspector authorised to take samples should have the power not only to take samples, but to seize?—Yes.

2129. Are you thinking of seizure in the case of beer on the retailer's premises, or upon the brewer's premises?—I am thinking of it in connection with beers upon the retailer's premises, because the Inland Revenue Department ought to have control of the brewers.

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2130. How do you suggest that the inspectors should identify the beer which he would seize in the retailer's premises, after analysis is complete, as being the same as that from which he took the sample?—That would be a very difficult matter. The fact of having seized a sample in a certain house would direct attention to a certain brewery, and special steps might be taken on the part of the Inland Revenue Department to ascertain whether any beers contained arsenic, or that there was arsenic in any of the materials.

2131. Are you thinking of seizure under the provisions of the Public Health Act?—The same sort of thing.

2132. Would the inspector, as the law stands at present, have power to seize on the premises of the retailer?—I do not think so.

2133. If he has taken a sample of beer which proves on analysis to be contaminated, and he can identify that sample with a stock, would that bring the case within his powers under the Public Health Act?—I do not think so, but I do not know.

2134. Are those the powers you want?—Those are the powers we want.

2135. (*Sir William Church.*) You do not yourself think that it would be a sufficient safeguard if the sulphuric acid was sold guaranteed pure, do you?—From the public point of view I do not think so.

2136. But if it was made from sulphur you would require a guarantee, would you not, that it was pure?—Yes, certainly.

2137. (*Chairman.*) With reference to the Inland Revenue Department, there would be no check upon the sulphuric acid used in the manufacture of other articles of food or drink, would there?—No, there would not.

2138. Under the Sale of Food and Drugs Act would the sanitary authorities be a sufficient protection to the public against arsenical sulphuric acid being used in other things than beer?—I think so.

2139. (*Sir William Church.*) What is your reason for thinking that there would be a much greater safeguard if only acid from sulphur was allowed to be used in the preparation of food products?—Because I understand that sulphuric acid manufactured from sulphur is not likely to contain arsenic.

2140. But it may, may it not?—Well, I suppose it might, but it is not likely to.

2141. Would common sulphuric acid that had been purified be likely to contain arsenic?—No; I believe it can be purified, but then that involves the necessity of purifying.

2142. (*Sir William Hart-Dyke.*) You mean the double process in the one case and the one process in the other?—Yes.

2143. And there would be greater security in the one in the form of guarantee than there would be if the cleansing process were necessary?—Yes, that is my idea.

2144. (*Chairman.*) The mere guarantee of Sicilian sulphur would scarcely be enough, would it?—I am not sufficiently familiar with the process to be able to say yes or no to that; but I am simply taking it for granted that sulphuric acid made from sulphur is not likely to contain arsenic, whereas it is very likely to contain arsenic if it is made from pyrites.

2145. But in every case the sulphuric acid itself must be tested, whether made from Sicilian sulphur or from pyrites?—Yes, certainly.

2146. (*Sir William Hart-Dyke.*) Would you go so far with regard to this future security for the consumer as to have a penalty inflicted on any manufacturer who used pyrites for manufacturing sulphuric acid for food or for brewing purposes?—Certainly I would, if it could be shown that he knew that the sulphuric acid was intended for that purpose. There ought to be a penalty attaching to it.

2147. (*Chairman.*) Do you not think that sulphuric acid should be guaranteed whether it is intended for food or not; that if it is to be freely sold it is to be guaranteed that it does not contain quantities of arsenic?—Sulphuric acid is used largely for other purposes in which it does not matter whether it contains arsenic or not.

2148. Would it be safe with regard to manure to have a large quantity of arsenic in sulphuric acid; might it not get into the roots of turnips and other things?—That I cannot express an opinion about.

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Advantage of acid from brimstone.

Dr. G. Reid. 2149. (Sir W. Hart-Dyke.) Would you suggest that officers of the Inland Revenue should periodically collect samples and analyse them?—I do.

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Analyses for arsenic should be systematically made by Inland Revenue.

2150. Not for the purposes of the Inland Revenue so much as for the purposes of the protection of the consumer?—Yes.

2151. But would you not go a little further, and suggest that there should be a constant process of analysis of samples going on?—It would be rather difficult to know where to stop. I think a check of this sort would be sufficient to prevent the practice. I should say it would be hardly possible to analyse every sample of brewing material obtained by the brewer.

2152. It would involve great expenditure?—Yes; it would involve great expenditure and a large staff of inspectors.

2153. You think that the fact of it being generally known by sugar makers and brewers—all those connected with glucose, whether in the manufacture of beer or other articles of consumption, such as confectionery—that these constant analyses were going on at headquarters by the Inland Revenue would in itself cause much greater care to be used in the future than in the past?—Undoubtedly.

2154. The fact that these analyses were constantly going on, and it being known that the officers were so employed, would be a deterrent?—That is my experience under the Sale of Food and Drugs Act. The larger the number of samples collected, the less the adulteration.

2155. That is your experience of the working of the Sale of Food and Drugs Act?—Yes.

Use of brimstone acid.

2156. (Professor Thorpe.) Do you know what the relative proportion of oil of vitriol made from pyrites or from sulphur is at the present moment?—No, I do not.

2157. Would you be surprised to learn that 98 per cent. of the oil of vitriol made at the present time is made from pyrites?—Very likely.

2158. Would you be surprised to learn that the purest form of oil of vitriol used in chemical laboratories for testing is made from pyrites?—That may be so.

2159. Is it not also a fact that the greater portion of glucose made and certified to be free from arsenic is made from pyrites acid?—That I cannot tell.

2160. If it were shown to you that by far the larger proportion of glucose and invert was made from pyrites acid purified from arsenic; that such products have not been known to contain arsenic, or have not been found to contain it, would you think, under those circumstances, that sufficient cause had been made out for disturbing the practice of these manufacturers?—I think so, certainly.

2161. Why?—Simply because the public are entitled to have the assurance that every precaution will be taken in the future, and they would not have that assurance if they realised that a substance used in the manufacture was prepared in a manner which necessitated a process of purification being carried out before it could be used with safety.

2162. What would happen in the case of sulphuric acid manufactured from sulphur which contained arsenic?—Of course, that would be ascertained before the acid was sent out, but there is considerably less likelihood, I understand, of an accident of that sort occurring in the case of acid made from sulphur than when made from pyrites.

2163. But if you were told that every sample of sulphuric acid made from sulphur contained arsenic, and that the amount of arsenic was so small that there would be no necessity for it to be purified, would not a greater evil be produced by the oil of vitriol made from sulphur than by oil of vitriol which had been designedly purified?—In the former case arsenic would be present in such minute quantity that it would not be detectable when so largely diluted in the brewing process.

2164. Perhaps you do not know sufficient of the occurrence of arsenious oxide in native sulphur to speak on that point?—No.

2165. You do not know that from time to time "pockets" containing arsenious acid are met with in native sulphur?—That may be so; but I cannot say.

2166. You do not know, I suppose, that a large quantity of sulphur is now recovered, and could be used in the manufacture of oil of vitriol?—Recovered from what?

2167. Recovered as a by-product?—No; I do not know that.

2168. And that as a by-product it may contain arsenic?—I do not know.

2169. (Chairman.) You think it would not be safe to trust to Etna never giving us any sulphur containing arsenic?—Probably not.

2170. So the ultimate test must be the purity of the acid given out?—Yes.

2171. (Professor Thorpe.) What amount of supervision does your suggestion in your own mind entail? What amount of supervision, say, on the part of the Inland Revenue officials, is included? What amount of analysis do you suggest? Is everything that goes into a brewery to be analysed by the Inland Revenue officials, in your opinion?—Certainly not.

2172. What precise extent of analytical supervision are you thinking of?—To the extent which is usually carried out in well administered districts under the Sale of Food and Drugs Act.

2173. You mean, then, an occasional check sample?—More than that; I mean periodical collection.

2174. Do you think that if analyses of samples of brewery products were taken of the number and quantity of samples taken under the Sale of Food and Drugs Act, that the volume of food taken as samples should have the same relation to the food consumed as under that Act?—I suggest more than that, because the reason that samples are not taken in relatively larger number is because of the enormous work which would be involved in the case of food. Considerably less work would be involved in the case of breweries for this particular purpose.

2175. Would there be any difficulties arising from the fact that glucose or invert and other brewing materials generally come in every day in large quantities in any big concern?—Yes.

2176. Is it your contention that every one of those articles should be tested by an Inland Revenue officer?—Certainly not.

2177. What proportion should be tested, in your opinion?—I am afraid I cannot tell you beyond saying that tests should be made periodically. The fact that samples will be taken periodically, when known, will be a wholesome deterrent, and I would suggest also that the officer should inquire into the guarantee accompanying each lot of materials supplied.

2178. I agree with you that some central authority, say—the Inland Revenue Department, might be called upon to ascertain that the system of guarantees was properly enforced, but as an administrative matter—and I speak with some knowledge of the practice of breweries and of the volume of produce dealt with by them—I venture to say that anything like a check by a systematic examination by Inland Revenue officials only would be absolutely impossible?—Well, from the point of view of food and drugs, we may take into account the enormous volume of milk consumed in the country and sent from different centres into various parts. The actual adulteration of milk can be largely regulated by the number of samples collected in a county. Surely that would indicate that supervision in the case of brewers directed to the materials they use would at any rate keep the subject before them and prevent any recurrence of this present catastrophe in the future.

2179. Your illustration in regard to milk is a little unfortunate, because I have been sitting upon a committee which has had this question as to standards regulating the milk supply before them, and we obtained a large volume of evidence which went to show that the system of inspection, although in some cases apparently adequately carried out, has not acted to the extent you say, that is to say, it has not prevented the adulteration of milk?—That is not my experience, at any rate; because we have tested it more than once, and have found that the relative frequency of attempts at adulteration is lessened by the frequency of the demand for samples.

2180. No doubt there is some relation between the two; the more vigilance is exercised, the less adulteration is practised?—Yes; but in that case it is an adulteration upon which you must, or you may place a limit; but in this case the question is one of the presence or absence of a material. Also in the former case the adulteration is a deliberate act, whereas in the latter, so far as the brewer is concerned at any rate, it is an accident.

2181. You quote that as an evidence that a large num-

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Extent of analytic control of Revenue necessary safety.

ber of analyses did act as a deterrent in checking adulteration?—Yes.

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2132. But I venture to say from what I have just told you, that the evidence we had shows it is not necessarily so?—I am surprised to hear that.

2133. If you read the report of that Committee you will see that in spite of the activity of the officers the amount of adulteration which continued in milk was very large?—So one would infer from that that it was advisable not to have a system of sampling?

2134. (Professor Thorpe.) I do not say that; but there is other machinery.

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2135. (Dr. Whitelegge.) What size of samples do you take in the case of beer?—As a rule, they have taken, I believe, an ordinary quart sample.

2136. Has that been found sufficient for the purposes of analysis?—I believe so—for the purpose of ascertaining the presence of arsenic. I do not know whether Mr. Jones required a larger quantity for quantitative tests; I cannot tell you.

2137. Have you given any instructions with regard to that?—No.

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2138. In the action you have taken, have you worked under official instruction of any kind?—Only under the instructions of my own council.

2139. Not under the instructions of any Government department?—We had a communication from the Local Government Board, suggesting that we should make an inquiry into this matter; but we had already proceeded with the inquiry at least a fortnight before that suggestion arrived.

2140. Was that the circular of the 11th of December?—Yes, that would be so.

2141. Was that sent to you officially, or to the County Council?—To the County Council, officially.

2142. Apart from that, have you had any instructions?—No.

2143. And I understand you did not make any report upon that subject to the Local Government Board?—No, not officially.

2144. Have you made a report to the County Council?—Yes, I have. A copy of my report to my Council was forwarded to the Local Government Board by the clerk of my Council I believe, and I forwarded copies to the Medical Inspectors of the Board.

2145. Upon what date, approximately, did you begin to take action with reference to arsenic in beer?—I brought it before my committee on the 1st of December.

Dr. THOMAS STEVENSON, called; and Examined.

Dr.
Stevenson.

2212. (Chairman.) You are Vice-President of the Chemical Society and of the Institute of Chemistry?—Yes.

2213. And lecturer on Forensic Medicine at Guy's Hospital?—Yes.

2214. And Scientific Analyst to the Home Office?—Yes.

2215. You have made a study of toxicology for nearly forty years?—Yes.

2216. You have analysed for the Home Office?—Yes, for nearly thirty years.

2217. And you have paid special attention to arsenic?—Yes.

2218. Clinically, pathologically, and analytically?—Yes.

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2219. And you went to Manchester early in the epidemic?—Yes. I went to Manchester on the 28th November last. I inspected the dead bodies of two women, Dyer and McCabe, in the Crumpsall Mortuary. I saw and examined a considerable number of women and men in the Crumpsall Infirmary. I arrived at the conclusion from the examination of these patients that they were suffering from chronic arsenical poisoning, and I also formed the opinion from the inspection of the bodies of the two women, and hearing their symptoms from the medical officer, that they had probably died from arsenical poisoning.

2220. Had you heard of the suspicion that had been raised a short time before the 27th November?—Yes. Dr. Dixon Mann saw me in London on the 23rd

2196. At that time, had any action been taken within the county by that authority?—No.

2197. Was action being taken in the county boroughs?—Action was taken by the county boroughs subsequently, but I do not think at that time any action had been taken by them.

2198. So that the initiative fell upon you?—Yes, it did.

2199. And at the later stages action was taken in the county boroughs?—Yes.

2200. But not by any local authorities—I mean smaller local authorities?—No; not by the smaller local authorities; not that I am aware of. Later on, in the case of some local authorities enquiry up to a point was made, but in most cases it was thought that the steps taken by the County Council were sufficient without any action locally.

2201. I understand that you have no direct authority over the inspectors who take samples?—No.

2202. You do not give instructions to the public analyst?—No.

2203. Were you acting in concert with him in the action you took?—Certainly.

2204. Have you any direct authority over officers of the smaller local authorities? You say you made certain suggestions to them. I take it they were merely suggestions?—Yes; suggestions only, made with the approval of my committee; I had not direct authority.

2205. Can you tell us anything as to the practice of the brewers in Staffordshire with regard to requiring a warranty? Has it been their practice to require a warranty previously?—No; I believe not.

2206. Has it been their practice to examine for arsenic?—No.

2207. Are any of them taking action at the present time with regard to that?—I believe so.

2208. Are they requiring warranties?—They are analysing for arsenic, and are obtaining and giving warranties.

2209. Brewers are analysing for arsenic, you say?—Yes; I believe they are. They are having samples submitted at the present time for analysis.

2210. In the absence of any further exercise of supervision by the Inland Revenue officers, would it be possible for the officers of any local or county authority to exercise control over brewers in the same way?—Yes; it would be possible if they had the power.

2211. But not under the present powers?—No; not under their present powers.

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By Borough and other local authorities.

November, and I went to Manchester knowing that arsenic had been found in the beer, and I had heard during the intervening days a good deal about the epidemic. I went round the Crumpsall Infirmary with your Secretary here—he was present—and Dr. Reynolds and the resident medical officers, who showed me many of the patients, and took me to see the dead bodies whose viscera I was asked to analyse. Then, at the request of the other members of the Brewers' Committee, and at the request of the solicitors to that committee, I was specially charged with the analysing of the viscera of the patients alleged to have died from arsenic. The matter being urgent, I obtained portions of the viscera of the two women, whose dead bodies I had seen, from Dr. Dixon Mann, and returned to London on the 28th, leaving my fellow-Commissioners to conduct the local investigations. Subsequently I obtained, through the coroners of Manchester and Salford, through the solicitors of the Brewers' Association, the viscera of three other women who were alleged to have died from arsenical poisoning. I ascertained from the medical officers of the Crumpsall Infirmary and from Dr. Buckley, who was a fellow-member of the expert committee of the brewers, a knowledge that all the five women whose dead bodies I had examined had been drinkers, and that three of them drank beer largely. Taking the dead bodies of the two women, Dyer and McCabe, the histories of their symptoms and the post-mortem appearances externally as seen by myself, such as pigmentation, and the rashes, and the excessive accumulation of epithelial scales on various parts of the body, all pointed to arsenic as being the cause of death. In

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four of these bodies out of the five I found arsenic in the viscera. In one case only was it in a notable amount; in three other cases the amounts were what I may term minimal. One of the five women, Alice Booker, died six days after ceasing to drink beer. I had 13½ oz. of her viscera.

2221. Which viscera was that?—The abdominal viscera: liver and intestinal canal. In Alice Booker a portion of the liver, kidney, spleen, loz. of the brain, formed the viscera that I examined.

2222. 13½ oz. ?—Yes.

2223. Is that ounce avoirdupois ?—Yes.

2224. Was that the total weight, 13½ oz. ?—Yes; the total weight I had was 13½ oz. I determined the amount of arsenic in all the viscera as '011, one-ninetieth of a grain of arsenic, calculated as arsenious oxide. This amounts to '0002 per cent.

2225. (Dr. Whitelegge.) Were the whole of the 13½ oz. of the viscera taken for this examination?—Nearly the whole; it was calculated on the whole.

2226. (Chairman.) And you extracted all the arsenic from that 13½ oz. of matter?—Practically the whole.

2227. What means did you take to measure the absolute amount of arsenious oxide?—It was precipitated eventually as a sulphide of arsenic.

2228. It is a very small part of a grain, '011?—It is.

2229. Is it enough to measure?—It is a quantity which is quite appreciable.

2230. (Dr. Whitelegge.) And measurable gravimetrically?—Yes, and also the fact that it was arsenic was determined by the method of Fresenius and Babo, and then converted into the crystals of the oxide of arsenic. It is a weighable portion.

2231. Can you give us any information as to the consumption of arsenicated beer by the patients in these cases?—This was the history furnished me by Dr. Buckley, who was a member of the expert committee. The illness commenced on the 25th September, the last date of taking the beer was the 21st November, and she died on the 27th November.

2232. (Chairman.) She had taken the beer during October after having been ill?—Presumably, as far as I know.

2233. She felt ill, but continued taking the beer during October?—Yes. And the average amount of beer taken was under one pint daily, according to her statement. I may add, however, that the statements of patients of this class with regard to the amount they take must be accepted with some reservation. A glass of beer with this class of patient more commonly means a pint at least. A glass of beer is half a pint, but when the person tells you she takes a glass of beer it probably means a couple at least. This woman was not a hospital patient.

2234. Her illness was treated in private practice?—She was attended by a Dr. Fergusson, who first visited her on the 21st November. That is the day she ceased to take beer. I suppose he knocked off the beer.

2235. Was it knocked off probably on his advice?—I do not know; but the fact is that she is stated to have taken no beer from the day the doctor visited her. This was at a period when the fact that arsenic was present in Manchester beers was already known in Manchester. Another case was that of Mrs. Thompson, who died 32 days after ceasing to drink beer.

2236. (Dr. Whitelegge.) Is the consumption known in that case?—The statement by Dr. Buckley was that the average amount of beer taken by her was a little over one pint daily.

2237. (Chairman.) You said that four of the women drank beer largely; you would not call a little over a pint daily "largely," would you?—No; I think a pint is not. I had a note of four of them; probably I should correct that, and say it was three who drank largely. Her viscera also yielded arsenic, but too small to weigh the amount.

2238. (Dr. Whitelegge.) Had you the same amount of material to work upon in that case?—No; it is rather singular that in the case of Booker I had less than in any other case. In the case of Thompson the viscera I had were 33½ oz., part of the liver, kidney, and part of the spleen.

2239. May we take it that the proportion of arsenious oxide recovered in that case was less than 1-90th of a grain?—Yes, less than 1-90th in the whole 33½ oz.

Another case was that of Alice Riley, who was alleged to have died 14 days after ceasing to drink beer.

2240. Can you give the amount of beer drunk? Is this one of the cases of large consumption?—Dr. Laing, who attended her, described her as a big, fat woman, over the average height, and from her appearance thought her addicted to drink. She admitted having drunk beer, and sometimes beer and whisky mixed. She never could be got to say how much she took. In that case the amount of arsenic was, as in the case of Thompson, unweighable.

2241. (Chairman.) With regard to this small amount of one-ninetieth of a grain in 13½ oz., if there was a small quantity throughout a large part of the body, that would amount to one grain in 90 lbs?—Yes.

2242. It might be a large quantity in the body, although there was only one-ninetieth of a grain in 13½ oz.?—It would amount to about 1½ grains in the body, which is nearly a fatal dose. But my experience is, that it is not equally distributed throughout the body.

2243. A larger proportion would be found in the viscera and the brain, and in the muscles?—Yes.

2244. And in the blood?—The amount in the blood I cannot speak of, so long after the cessation of the taking of arsenic.

2245. In the case of Alice Riley and Margaret McCabe, what did you find?—Alice Riley died 14 days after ceasing to take beer. She is the one I have just mentioned. Margaret McCabe died 52 days after ceasing to drink beer, and the amounts of arsenic were unweighable. She was a drinker, but what amounts of beer she took I do not know. There is this to be said with regard to her, that she had a cavity in the lung; she was no doubt consumptive.

2246. And that may possibly have been the cause of death, accelerated by the beer-drinking and arsenic?—It might have been. In the case of Margaret McCabe the body was very markedly pigmented all over. I can compare it to a Hindoo.

2247. Have you any doubt that was from arsenic?—From her history and other symptoms I have no doubt the pigmentation was due to arsenic.

2248. (Sir William Church.) Still, pigmentation often does occur in tubercular cases too?—Yes, but still it is a very marked case, and from the whole of her history and symptoms and finding the arsenic in the body I had no doubt in arriving at the conclusion that her death was from arsenic, or it might have been consumption accelerated by arsenic. The other case was that of Mary Jane Dyer. She died 23 days after ceasing to take beer. There was no history of how much beer she took, but she had the history of a woman who was generally a drinker, and took both spirits and beer. At the post mortem examination an enormous liver, weighing over 100 oz., and the appearance of the kidneys, all pointed to the fact that she was in a rather advanced state of alcoholism. But she had the history of arsenic, and the rashes, and the pigmentation of arsenic.

2249. (Dr. Whitelegge.) And neuritis?—She had the history of neuritis too. She was an enormously bloated woman, with rashes of an herpetic character, and pigmentation.

2250. Do you think her case was one of arsenical neuritis?—I think so, although I found no arsenic in her viscera after death.

2251. And you do not think that the absence of arsenic in the viscera after death negatives the diagnosis of arsenical poisoning?—No. I gave that evidence on the inquest on this woman, that I believed that she died from arsenical poisoning.

2252. (Chairman.) Probably at the time she ceased to drink beer there was much more arsenic in her viscera than there was 23 days later, when she died?—Undoubtedly that would be so.

2253. Every day would take some of it away?—I think so, yes. I must add with regard to these cases that Prof. Dixon Mann, of Owen's College, had duplicates of all this viscera, and he found arsenic in comparable amounts in all the cases, that is to say, he found an appreciable amount in Booker, and very minute quantities in the cases of the other women.

2254. (Dr. Whitelegge.) Not including Mary Jane Dyer?—In Mary Jane Dyer he found none also. The

Quantity of
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fatal cases.

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analyses we conducted separately, but before the inquiry we compared our results, and substantially they are the same.

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2255. Is it usual to test the viscera for arsenic without any special reason for suspicion in the case of a post-mortem examination?—Yes; I frequently do it. In fact, I always do it for any viscera submitted to me by the Home Office or the Treasury.

2256. Without reason to suspect arsenic you would still test for it?—Yes.

2257. And the small traces you have found in those five cases were all more than you have found in other cases in which you have looked for it?—Yes. I have found it occasionally in small quantities in some portion of the viscera, the spleen for instance, but if I do not find it generally and only in exceedingly small proportions, I could not form the conclusion from analysis alone that arsenic had been in any way the cause of death, but the history pointed to that conclusion. In all cases of analysis of this kind the facts of the chemical analysis must be supported by the clinical observations on the patients, or the lesions found after death.

2258. And you would not be surprised to find some small traces of arsenic in an ordinary case?—I should only exceptionally find it. Occasionally I have, but not commonly.

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2259. Is it a fact that the most rigorous analysis of viscera, or of spleen or liver of a healthy human body shows absolutely no trace of arsenic?—It is obvious I have never had an opportunity of examining the viscera of a healthy person, but in ordinary cases where there is a suspicion of poisoning, or in cases of patients in the wards of hospitals, and so on, one does find a very minute quantity exceptionally in some organ. For instance, last year I found it in the case of a patient who died in Guy's Hospital, in the spleen—I did not find it in the other organs.

2260. That was not a case of poisoning?—Not a case in which I could learn of any arsenic. The experiment was performed with the object of seeing whether arsenic was a normal constituent of the body or not. I found it in one organ and not in the others. Of course, I only examined a few of the organs.

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2261. You have been struck with the lengthened periods during which arsenic remained in the body?—Yes. Ordinarily, if a person is taking arsenic, or has been poisoned by arsenic and is recovering, one tests the excretions, and the urine is the one in which one especially looks for it. If you give a patient one dose of arsenic, say, a 14th or 15th of a grain, you can detect arsenic in the urine within an hour or two at the utmost, and in such cases I have examined the urine day by day for many days after arsenic has ceased to be administered; it sometimes disappears, so far as one can recognise, in four or five days, more often in seven or ten days, or a fortnight, and I do not think I have ever discovered it in more than from 21 to 25 days after it has been ceased to be taken. Exceptionally, however, others have found it for extraordinarily long periods, I think, for 60 or 90 days.

2262. Has that been after a large quantity of arsenic had been administered?—No; after a small quantity, but I think some doubt attaches to the experiments. It was a Russian who did it not long ago, but the quantities of sulphuric acid and zinc, and other materials which he employed in getting out the arsenic, especially as he records no blank experiments, throw great doubt upon his experiments. I think one member of the Commission will appreciate it, that if you take 70 or 80 grammes of sulphuric acid, and get, say, 1-100th or less of a milligramme of arsenic, it is quite possible you may get it from the material you employ, the quantity of material employed being so huge in comparison with the amount of material, say, 6 or 10 grammes taken for analysis. Scherbachoff made the experiments and recorded the experiments in April last year.

2263. (Chairman.) Can you find arsenic excreted by the skin?—Yes. I have made no special experiments in that direction myself, but M. Armand Gautier and others have found it in the skin; and M. Gautier goes so far as to say that it is a normal constituent of the skin. I have been in constant communication with my friend Dr. Dixon Mann in Manchester, and he has made special researches in the skin in these cases, and he finds arsenic in the skin, the epidemic scales which peel off the skin in these arsenical cases.

2264. But not in healthy subjects?—I do not think he has made any experiments in those. You must understand that in these cases you can peel off huge flakes in weighable amounts. You cannot get enough of the skin of a living individual to test it. With regard to the pigmentation, I was struck on going round the Crumpsall Infirmary and examining the patients, who were very numerous, alleged to be suffering from arsenical poisoning—they were all beer drinkers; I asked them all that question—with the amount of pigmentation. It was the rule, and not the exception. Pigmentation you will not find described in the text books, except recent ones, as being a very marked symptom; but it has been observed. I do not know that I have ever seen it when neuritis has followed acute arsenical poisoning; I have seen several cases—I saw a girl in consultation in Somersetshire, only about six weeks ago, who was poisoned by arsenic. She was one of the survivors, a girl of eleven, of a family who were poisoned; she had marked neuritis, and could not walk, but I could discover no pigmentation in her skin. A lady I saw some time ago had had her life attempted by arsenic—she recovered and had neuritis very severely; she had no pigmentation as far as I could make out.

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Pigmenta-
tion common
in Crumpsall
Infirmary
cases.

2265. (Chairman.) Was this just one poisonous dose?—This lady had had several $\frac{1}{2}$ grain doses, that is nearly a fatal dose.

2266. Taken by accident?—No, it was administered, I am afraid, with intent to poison.

2267. Was there an investigation?—No. The person who was alleged to have done it committed suicide, and nothing came of the case.

2268. Was the lady very ill afterwards?—She was very ill; so ill that the paralytic affection extended and invaded the lower muscles of respiration and the diaphragm, and great apprehensions were entertained for her life.

2269. Has she perfectly recovered?—Yes.

2270. Are there any evil results?—I lost sight of her eventually, but she was out of health for a long period. Pigmentation has been observed, and perhaps Sir Lauder Brunton will tell you about that. That was in what was termed the Hyères epidemic in the south of France, where from the plastering of vines by means of arsenic which was used instead of sulphate of lime, there was an extensive outbreak among the wine drinkers.

Hyères
epidemic

2271. Were there any deaths?—Yes; a good many deaths; I have not the details before me, but I think pigmentation was a marked feature in that epidemic. The quantity of arsenic in the wine I think was about 150 milligrammes in the litre in some cases. It is very difficult when you examine the liquor after the people have died to see what was the average amount, but I think Sir Lauder Brunton, who has the note of the facts before him, will tell you about the pigmentation in those cases.

2272. We have heard something of that already, and will hear more no doubt from Sir Lauder Brunton?—Yes.

2273. You mentioned acute arsenical poisoning only; Pigmentation is pigmentation common in chronic arsenical poisoning?—I do not think it is common.

2274. But it is known?—It is known.

2275. (Sir William Church.) It is known, is it not, as a result of arsenic given medicinally over a long period?—Yes. A well-known professional gentleman told me lately that he had been given arsenic, and that he was warned against the symptoms by the doctor; but he was not told about pigmentation, and his attention was attracted by the amount of discoloration he got about the face and hair.

2276. That has been known for a long time, has it not?—Yes.

2277. (Chairman.) Does the pigmentation disappear when the patient recovers?—Yes, it disappears in time, but it is a very long affair.

2278. It remains a long time?—Yes, because these deposits of pigment in extravascular organs, in parts like the skin, take a long time before they disappear. There is apparently not much absorption.

2279. (Professor Thorpe.) Do you know anything about the nature of the pigment—what is the pigmenting material?—I do not know.

2280. Do you know whether it is arsenical itself?—I do not know.

2281. (Dr. Whitelegge.) How many cases did you see at Crumpsall, roughly?—I saw a great many, but I think

Dr. T. Stevenson. I must have examined probably a dozen or 15 pretty closely. They all seemed to be repetitions of one another.

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2282. And was pigmentation common amongst them?—Yes.

2283. Can you tell us the proportion of pigmented cases to the whole number?—No. I did not take any notes at the time, and I left Dr. Luff and others to follow that up.

Arsenic in bones.

2284. (*Chairman.*) As to the arsenic lingering in the bones for lengthened periods, what do you say about that?—That has been asserted and denied, and re-asserted, and I cannot give any positive information on it. Orfila stated that it had been found in the bones, but he is refuted by Dr. Owen Rees, and he admitted he was wrong, and then it was re-asserted that it has been found in bones as well as in other organs.

Gastro-intestinal symptoms in epidemic.

2285. (*Sir William Church.*) Arsenic, you say, has engaged your attention very frequently, clinically, pathologically, and analytically. The symptoms that usually indicate arsenic poisoning are generally connected with the stomach and the intestines, are they not?—Yes, very frequently. Administered medicinally, as you know, the eyes and nose are often the first portion to suffer. There is irritation of the mucous membrane generally.

2286. Did the information you got at Manchester lead you to come to the conclusion that gastric and catarrhal symptoms were absent in a great many of these cases?—Gastric symptoms certainly were; catarrhal symptoms were more common, but still they were not universal. In a great many of the patients I saw you could see the injected conjunctiva of the eye, the watery appearance, and so on.

2287. Did many of them complain of irritation?—Some did, and in some you could see the symptoms, although they did not describe it. But when you get the bleary, watery eye of the people who are habitual drinkers, any observation of that kind is liable to be fallacious.

2288. Still, the absence of gastric symptoms was calculated, was it not, to make the medical men in the district slow in recognising that it was likely to be arsenic?—Certainly. With regard to the pigmentation, there is no doubt that when attention was drawn to it many out-patients of the hospital were stripped, and then pigmentation was found where it was previously not suspected.

Arsenic and alcoholic neuritis.

2289. With regard to the neuritis, the palsy, did it appear to you to differ in any way from what you had been acquainted with under the name of alcoholic neuritis?—No, except that it was very pronounced. If you took the patients' bed-clothes off, or touched them, they said it was like electric shocks, pins and needles, and numbness. The increased sensibility was very marked, more so than in most cases, I think, of alcoholic neuritis.

2290. But was the general appearance of the patients, the look of their eyes, their hands and their feet, and even of their faces, almost indistinguishable from what we have called alcoholic neuritis?—Yes, I think so.

2291. What did you attribute the actual causes of death to in those fatal cases?—I arrived at the conclusion that it was arsenic.

2292. I rather meant in what way did it act fatally?—Of course, the only case I saw in a dying condition was one in the Crumpsall Infirmary, whose viscera I had no opportunity of analysing. She was dying, apparently, from paralysis of the diaphragm.

2293. You would not like to say whether the others died chiefly from that cause, or from exhaustion, or other causes?—I cannot say that.

2294. You have told us that the liver of Mary Jane Dyer weighed over 100oz., and looked like that of a person in advanced alcoholism. What was the condition of the other livers, were they equally large, fatty livers, or what we more often call cirrhotic livers?—I have only had a portion of the livers of each, but the half I took of Dyer weighed 53oz. The only other case I can state the weight of would be that of McCabe. In the case of McCabe I am afraid I cannot give you the absolute amount, but I had 13½oz., and Dr. Dixon Mann had 16½oz., which would make 30oz. on the whole. That is below the full amount, of course. I did not make the post mortems.

Effect of arsenic on liver.

2295. Perhaps I can get what I want to know in this way: What is the usual effect of chronic poisoning by arsenic on the liver?—In the eventual stage you get contraction, cirrhosis, but if you have extensive kidney

disease and cardiac dilatation and so on, you may get an enormously large liver.

2296. Do you mean that chronic arsenic poisoning leads to cirrhosis?—No, I am speaking of alcohol.

2297. I was asking you about arsenic?—I do not know of any, except fatty degeneration. I have had to deal this year with an acute arsenical epidemic in a family. Five out of seven or eight people in one family died, and I think that in certainly two, and probably three, of those cases there was extensive fatty degeneration.

2298. Without great enlargement?—Yes.

2299. Therefore the enlargement that has been so commonly found, as we have had it in evidence before us in these cases, at Manchester and Liverpool, point to the probability of their being alcoholic as well?—Yes. I came to the conclusion from Dyer's viscera that she was an alcoholic. With regard to arsenic, fatty degeneration, in an extensive form at all events, is the exception rather than the rule. But you do observe it from time to time.

2300. Does chronic arsenic poisoning have any effect upon the heart muscle?—I cannot speak of my own observation, but it is said to cause fatty degeneration of it.

2301. You know that the medical officers attending these cases have found that dilatation of the heart has been very frequent in the fatal cases?—Yes.

2302. Would you associate that probably with the action of arsenic upon the heart?—I think so. The cases I saw in the hospital were, I should say, obviously cases of dilatation.

2303. (*Dr. Whitelegge.*) Do you regard alcoholism as predisposing to arsenical poisoning?—I have no opinion on that point. I have not had an opportunity, previous to this epidemic, of observing it.

2304. (*Sir William Church.*) Have you formed any opinion as to whether it is possible that arsenic, when introduced into such substances as beer in the process of manufacture, can enter into a chemical combination which we are not well acquainted with, and may have a more prejudicial effect upon health than ordinary arsenious oxide?—Do you mean in the beer itself?

Question combining of arsenic with the organic matter in beer.

2305. Yes?—I know of no evidence of that. Of course there are what are called the cacodylic compounds—we take those for example, and generally those are less potent than arsenic in the arsenious or arsenic form, the mineral form, if I may use the term. But the examination of the beers leads me to the conclusion that it is probably altogether, or practically altogether, in the form of an arsenite. When you treat organic combinations, or even viscera containing small quantities of arsenic, by the Reinsch test, boiling with copper and hydrochloric acid, you may get a slow deposit of arsenic on the copper, but with respect to the beers it comes down quickly and readily in the form of arsenic. I do not go so far as Professor Delépine, who told me that you can detect arsenic in beer by Reinsch's test much more readily than in water. At all events you can detect it as readily, I think. There is no evidence whatever, so far as I know, from the chemical examination, to show that there is arsenic in an organic combination.

2306. That hypothesis has been already put to us?—I have heard of that, and I have discussed the matter with people, and it has been said by some of them to account for what I may call the anomalous symptoms observed in these cases of beer drinking; but there is no positive evidence in support of it, as far as I know.

(*Chairman.*) It has been asserted that arsenic is a normal constituent of the human body?—It has been asserted, and it has been denied again and again.

Arsenic stated to be in normal human

2307. In the thymus and thyroid glands?—Armand Gautier asserted within the last two years he found it in the thymus, the thyroid, in the skin, and did not find it in the blood or the uterus, but found it in the foetus and the bone of the foetus in the uterus, and found it even in cow's milk, in operating on three litres. I cannot from my own analysis and examination of the experience of others arrive at the conclusion that when found it is anything but adventitious; it is not normal. It is very difficult to say, when you examine a portion of the body analytically, that the person has never taken arsenic. We know that arsenic does exceptionally linger in the body for lengthened periods, and I know from my own experiments and from the experiments of others that the sources of arsenic in the human body are very numerous. I do not mean to say arsenic in an important amount, but arsenic in excessively minute amounts.

Dr. Stevenson. 2308. (Professor Thorpe.) Is there anything *a priori* absurd in the supposition that arsenic would tend to accumulate in the bone? The close affinity of arsenic acid to phosphoric acid, the fact that they are so constantly associated in nature, that they mutually replace one another in nature—a large number of minerals, for example, crystallising in the same form—would you not *a priori* expect that arsenic acid may be found in union with lime in the bone?—There is nothing improbable in that. In fact, M. Gautier asserts that it is in those portions of the body which contain phosphorus that you find arsenic. He says arsenic replaces phosphorus in what he terms the nucleins. It is possible in bones, but I have examined a number of bones, and as a rule I found none in the bones. In the bones of persons who have been poisoned by arsenic that I have examined I have found none, and I think as a rule one does not find notable amounts of arsenic there more than in other portions of the body.

2309. But arsenic is sometimes found in the ashes of wheat, for example, replacing apparently the isomorphous phosphoric acid?—That is the supposition, that it replaces phosphoric acid normally. Wheat is often grown on arsenical soils, and arsenical manures are in constant use for manuring the soil.

2310. (Chairman.) Is not that a danger?—There is a danger of the introduction of small amounts into the body.

2311. And is there not a danger of introducing it into the food?—Yes.

2312. (Sir William Hart-Dyke.) Are you referring to artificial manures only, or would you include what is called the common farmyard manure?—The superphosphates, the artificial manure—that is to say, the superphosphates made with pyritic sulphuric acid.

2313. (Professor Thorpe.) Do you imagine that all the arsenic found in these manures comes from the use of the oil of vitriol, and is not pre-existent in the bone phosphates converted into superphosphates?—There may be some, but of course the use of mineral phosphates containing arsenic may introduce some of it. Probably the sulphuric acid is the main factor. In the manufacture, not only of superphosphates, but of sulphate of ammonia in gas works, you get sulphide of arsenic separating sometimes as a yellow substance in the neutralisation of the gas liquors.

2314. Arsenic acid is not so poisonous as arsenious acid, is it?—It is generally believed to be slightly less so, but I think the opinion of the medical practitioners, if you may judge from the pharmacopoeia and the quantities prescribed, is that the amount of arsenic prescribed as arsenate is pretty much the same, rather less in fact, than the amount prescribed as the arsenious compound.

2315. Have any exact observations been made as to the relative toxic effect?—None very exact, I am afraid.

2316. Would they be complicated by the fact that the arsenate might be reduced to arsenious oxide?—It might, and a greater liability of the arsenates to form insoluble compounds. Insoluble compounds are much less poisonous than soluble compounds.

2317. (Chairman.) May insoluble compounds not remain in the body and become decomposed into soluble compounds?—Yes; even the arsenate of calcium, the arsenate of lime, is, like most other bodies, to some extent soluble, although very little. It may pass into solution again, but still it can only pass slowly into solution when once formed.

2318. (Professor Thorpe.) The hydrochloric acid of the gastric juice would dissolve the arsenate, would it not?—Yes, if introduced into the stomach; but I am speaking rather of the other portions of the body remote from the stomach. Almost any poison when introduced into the gastric juice would quickly pass into the circulation.

2319. For example, supposing that arsenate of lime was present replacing phosphate of lime, or alumina in wheat, that would do its work as a poison by the action of the hydrochloric acid of the gastric juice?—Yes.

2320. (Chairman.) I suppose we may take it that an absolutely insoluble substance could not be a poison, and that it is only when very sparingly soluble substances, or substances insoluble in water, meet with solvents in the body that they become poisonous?—Sulphate of barium is a signal instance. All the barium except the sulphate are poisonous. It is even asserted that the yellow sulphide of arsenic, which is practically insoluble, is non-poisonous.

2321. Is yellow sulphide of arsenic not attacked by any liquors that it meets in the human body?—It would be attacked by alkaline liquids; but in the acid liquors it is practically insoluble.

2322. And it would not meet alkaline liquids in a healthy body?—When it passes beyond the stomach it would, but they would be so very faintly alkaline that it is very doubtful whether much solvent action would be exerted. Many articles of food may contain arsenic. I have already mentioned those that are grown, vegetables grown on arsenical soils, and arsenic in the soil is by no means a rare occurrence. The use of manures in the preparation of which arsenical sulphuric acid is used increases the chances of a mixture of arsenic with vegetables. Then the use of weed killers, strong compounds of arsenic used in gardens, may introduce arsenic into our food. This is not my own observation, but it has been said to be found in cruciferous plants, such as turnips and cabbages, and even in the potato. I may state that the superphosphates are largely used for the growing of turnips. Many chalybeate waters are arsenical; the Vichy and others, I think, contain arsenic, and the ferruginous deposits from waters that are good for drinking purposes often contain arsenic, even when the water is practically arsenic free. The ferruginous deposits you see about drain pipes, if examined, are found to contain arsenic, and if you examine water in the ordinary way you may find no arsenic; that is to say, the arsenic is present probably in very minute amounts, so that they escape detection except a large volume of water is employed. Rivers from which drinking water is obtained may contain arsenic, which is frequently cast into the rivers from tanneries, for instance.

2323. Do you know of any recorded facts with reference to arsenic found in turnips and cabbages?—I cannot give the reference, but Gauthier, in his paper, which appeared in the *Comptes Rendus* about two years ago, mentioned the fact that it has been observed there.

2324. Does he state facts in detail?—I do not think he does.

2325. Is he a French writer?—Yes.

2326. Is he a medical man?—He is a medical writer and a chemist of some distinction.

2327. You say that many chalybeate waters are arsenical, and that rivers from which drinking water is obtained may contain arsenic? Have you any statement as to the quantities of arsenic in such cases?—No; it must be small. I have examined the liquors from tanneries, and the substances they use, and they are arsenical. They are thrown into the river.

2328. That arsenic in the river, you mean, comes from preparations used by tanners?—Yes, what are termed depilatories, substances used to deprive the pelt of the hair.

2329. What substances are they?—Formerly they were chiefly a mixture of yellow sulphide with lime, but those are largely superseded by substances which are sold under fancy names, which the tanners do not always know contain arsenic; but they are really compounds of arsenic with an alkali, such as soda and lime.

2330. (Dr. Whitelegge.) And are not hides imported into this country which are arsenicated with the idea of curing or preserving them?—I believe so.

2331. (Chairman.) Arsenic is also used, is it not, to preserve natural history specimens, the skins of birds and beasts, and so on?—That is so sometimes, but it is found that in sheepskins if you immerse the sheepskins in a mixture of lime and water you can pluck the wool off easily. It acts as a depilatory. But in the imported skins of French lambs, and the Australian skins, they find that by using a compound of lime and arsenic, or lime and soda, instead of lime alone, the wool may be brought off in a fraction of the time which is required when lime alone is used.

2332. Will lime and soda answer as well as lime and arsenic?—They do answer, but they are longer about it.

2333. So that they prefer arsenic?—They use arsenic freely.

2334. Is not that dangerous to the health of the persons employed in a tannery?—Yes.

2335. Are there cases of arsenical poisoning in tanneries?—I have met with them, serious ones too. But when one has pointed out to the masters the danger they take precautions. I have seen numbers of men in tanneries who were affected, that is to say, they got their

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Manured vegetables.

Arsenic in hides.

Dr. T. Stevenson. 13 Mar. 1901. cheeks affected, and their eyes, their lips, and their genitals, from handling them with unclean hands, when urinating, and they get troublesome sores. But of late years I have met with no such cases, because I think the masters are well aware of the risk they run.

2336. (Dr. Whitelegge.) Are these symptoms entirely external, or have you met with cases where they have been internal, or constitutional?—No, not constitutional symptoms.

2337. (Professor Thorpe.) Have you met with any palsy?—No. They get the particles of this stuff on their fingers, and carry them to various parts of the body, and thus set up local irritation, generally irritating sores. I saw a man once who had his cheek perforated with such a sore.

2337*. (Chairman.) Was he a tanner?—Yes.

2338. Is there not a danger from leather gloves prepared in that way, a danger to the wearer by reason of the arsenic contained in the leather?—I think in regard to skins that they mostly use mercury compounds, and there there is a danger to the workpeople also, as I recently pointed out to the Home Office. I have seen several cases in people making felt hats, cases due to mercury.

2339. But with regard to leather, prepared by the use of arsenic in a tannery, is not that dangerous when used in the ordinary articles, trunks, portmanteaux, and skins in houses? Does not that raise the same kind of danger as arsenical wall-papers?—I cannot instance any causes where evil results have followed, except to the workers, from such materials.

2340. (Professor Thorpe.) Has the German Government taken any action in their general sanitary law about these things prepared with arsenical compounds?—I do not know. Probably if anyone did the Germans would, but I cannot specify, as I am not acquainted with the German law.

2341. (Chairman.) Have you any quantitative results as to the amount of arsenic found in ferruginous deposits from waters?—No, I have not. Again, we have the application of arsenical compounds to such things as apples. In America they syringe the apples and the apple trees with arsenical compounds, and the vines, to destroy the blight. These, of course, are a source of conveying arsenic into the system. Arsenic may thus get into preserved apples, in apple chips which have been imported.

2342. In poisonous quantity?—In small quantities. It is difficult to say what is a poisonous quantity.

2343. Have you heard of arsenical illness traceable to such causes?—Not in this country.

2344. Have you heard of arsenic in tinned fruits or tinned vegetables?—No; those do not generally contain arsenic, but they contain lead and zinc sometimes. I have not met with arsenic in those myself.

2345. (Sir William Church.) In the case of imported apple chips and apples containing arsenic, do you think that arsenic was contained actually in the apple, or was it accidental contamination at the time the chips were dried?—They use arsenical compounds for syringing apples.

2346. That is, they syringe the growing apples?—Yes.

2347. I should have thought it was more likely that arsenic found in the apples themselves and the apple chips came from some accidental contamination during the process of manufacture or drying. Do you think the arsenic got in in the peeling of the apples from the arsenic remaining on the peel all the time?—I think it is quite possible, and far more likely than to occur in the process of drying the apples.

2348. It is the same thing. The arsenic was not inside the apples?—No.

2349. Then it has been an accidental contamination of the apple pulp?—From the skin?

2350. Either from the skin or something else?—Yes.

2351. (Chairman.) If arsenic has been used in the skin, could not small portions be absorbed into the apple in moistening it and dissolving some of it?—It is possible, I think, but not very probable.

2352. I believe you have something to say about the use of arsenic for sheep dips?—Sheep dips are commonly arsenical, and I suppose some of it is very likely to be absorbed into the body of the sheep, just as we

know that if arsenic is applied to the skin of animals and human beings it is absorbed.

2353-5. I am told that it has been stated in a recent number of the "Daily Mail" that arsenic is used in the food for fattening poultry?—I do not know anything about that. It is said that the Strasburg geese were fattened by means of antimony.

2356. It was stated that for the ordinary fattening of poultry food containing arsenic was used to facilitate the fattening?—It is impossible for me to deny it, but I have never heard of it. We have arsenic, of course, given off during the burning of coal and coke, and soot is decidedly arsenical; I think it has been stated to contain as much as 1 per 1,000 of arsenic, and the soot-laden air of our cities does certainly contain occasionally detectable quantities of arsenic. Smoked articles of food are exposed to arsenic. It has been found in hams which have been dried by means of coke fires. I suppose, as gas coke is commonly used in London, the chops and steaks, and grills generally cannot fail to contain some arsenic.

2357. Our only safety then would be the use of electric grills?—I do not say it is unsafe. I am merely pointing out the innumerable sources of quite considerable amounts of arsenic in our food supplies. There is a method of preserving food by the use of borates which introduce arsenic into the food. I have this year examined a large number of samples of borax and some samples of boric acid, and I have not found one absolutely free from arsenic, although in one case I had some specially prepared for me with carbonate of soda. It is small, but still there are traces of arsenic.

2358. (Dr. Whitelegge.) What is the maximum you found in borax?—The maximum I found was .35 of a grain, calculated as arsenious oxide, per pound of borax.

2359. (Chairman.) That would be about 1 part in 20,000?—Yes, about that. That was a sample which I believed was analysed by a Glasgow chemist also, who found .4, practically the same amount.

2360. Have you always found arsenic in borax?—Yes, but that is the largest amount. It usually contains about 1-10th of that amount.

2361. (Professor Thorpe.) Does that come from the oil of vitriol used or from the natural deposits from which the borax is made?—I think from the natural deposits. The manufacturers tell me that borate of lime, which is used in the preparation of these things, often contains a good deal of arsenic.

2362. (Chairman.) Borax is largely used for the preservation of milk, is it not?—Yes; and cream, fish—fresh, salted, and dried—game; and the poulterers largely use the borates in summer weather. A mixture of boric acid and borate of sodium is commonly used for dusting over game, fish, and those kind of things which are liable to decomposition.

2362a. And the quantity of arsenic in it would be a source of danger, do you think?—I do not think it is a source of danger, but is a source of arsenic.

2363. May the quantity be larger in milk?—One part of borate in 1,000 or 2,000 of milk is a common quantity.

(Dr. Whitelegge.) Is boric acid made from borax?—Borax is made from boric acid; that is to say, the borates of lime or calcium are used and the boric acid is separated. I believe a great deal of borax is made from the boric acid, but I have never seen it made.

2364. Is sulphuric acid used in the manufacture of boric acid or borax?—Yes; sulphuric acid, or hydrochloric acid, or both, but the natural material is borates, which frequently contains minute quantities of arsenic—at least, so the manufacturers who make these things tell me.

2365. Have you found arsenic in boric acid as well as borax?—Yes. I mention these sources of the introduction of arsenic into the body, not that I think significant quantities are thereby introduced into the body, but to point out that some allowance must be made and some agreement come to as to the quantity of arsenic which is permissible, if any is permissible at all, in articles of food, drink, and drugs. The term "arsenic free" must have some reasonably analytical interpretation put upon it.

2366. (Chairman.) I think you scarcely mean to say "permissible," but rather avoidable?—That would be a better word. There are many points which I have not

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Liability of apples to contain arsenic.

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in smoked hams,

in boric

in borax

Dr. Stevenson. cleared up yet; and perhaps some opportunity may be given to me on a future occasion to bring them before the Commission.

Mar. 1901. 2367. We shall be very glad to hear anything you can give us, either now or at some other time?—I am engaged with my fellow-experts in making investigations as to the sources of arsenic in beer, and the means by which they might be avoided—coke, coal, acids, malts, hops, and so on, and our experiments are not yet completed.

2368. As a rule, can arsenic be easily removed from the chemical known to contain it; for instance, from boric acid or borax?—No.

2369. I am told that it is quite easy to remove it from sulphuric acid?—Yes. I have seen practically the whole of it removed.

2370. But not from boric acid?—No.

2371. (Dr. Whitelegge.) How does the difficulty arise in the case of boric acid?—If you re-crystallise it again and again some of the arsenic will still attach itself to the boric acid or the borate. When you get two substances together in the form of crystals it is often very difficult to entirely separate one from the other by re-crystallisation.

2372. (Chairman.) Can the arsenic not be precipitated by sulphuretted hydrogen or otherwise from a solution of the substance?—In the quantities present I do not think it is practicable. For instance, in the samples of borax I have examined when you dissolve the borax and acidify it to keep the boric acid in solution you have such a dilute solution that the arsenic cannot be precipitated by sulphuretted hydrogen; whereas if you distill the boric acid or the borax with hydrochloric acid, you get the distillate, but the difficulty of separating it commercially, to remove the least trace, is enormous, and I believe I may say quite unnecessary and no source of danger to the public.

2373. (Chairman.) Is it practically innocuous?—Yes.

2374. (Professor Thorpe.) In that particular case I quite agree that the amount is negligible, but if it were a matter of importance to free it even from boric acid or borax, I do not think there would be any difficulty in doing it?—I do not think the difficulty would be insuperable, but it would be a very troublesome and costly process. I think the chemist, if he makes up his mind to separate any ingredient, can generally manage to do it in the end.

2375. Take the case of the boracic acid. That perhaps would be remarkably easy, because the curious point about boracic acid is that, although pretty soluble in hot water, it is not so in cold water, so that if one were to take borax or borate of lime containing arsenic, and one were to treat it, as one does in the process of manufacture, with hydrochloric acid, the greater quantity of the arsenic would remain in the mother liquor and the boracic acid would be thrown out?—Yes.

2376. That would leave it practically, or very nearly, free, and a repetition of that process would practically get down the arsenic to a negligible quantity, would it not?—Yes, in the greater proportions of boric or boracic acid I have examined the quantity is very small; it does not amount to more than 1-20, 1-30, or 1-100 of a grain per lb. It is negligible as regards health purposes.

2377. But if I might be allowed to pursue that, of course you would draw a sharp line of distinction between arsenic introduced into products which may enter into the compounds of food and sulphuric acid, and the arsenic introduced into products where the arsenic, so to speak, is of a natural origin. Now, I presume it would not be difficult to exclude arsenic introduced into foods by sulphuric acid incidentally?—No, it would not.

2378. It might be more difficult to exclude it in articles of food derived from natural products which themselves might contain arsenic?—Yes.

2379. But in so far as these natural products were derived from the use of arsenicated manures, which were themselves derived from oil of vitriol, it ought not to be difficult to exclude them?—No; prohibit the use of arsenical sulphuric acid in the preparation of manures and that source is removed.

2380. How many substances occur to you containing arsenic derived from what may be called a natural origin?—It is difficult to say; but the borates, the phosphates, phosphate of sodium, and so on.

2381. May I ask you about the phosphate of soda? We know that occasionally samples of phosphates of soda are

found to be associated with arsenate of soda, but in that case how is the arsenic derived?—It may be from the sulphuric acid, or it may be possibly from the carbonate of soda.

2382. But even from the carbonate of soda, if it is in the carbonate of soda it has been derived from the sulphuric acid?—Yes, soda made from sulphuric acid.

2383. By the Leblanc process it would be obtained from the sulphuric acid?—Yes.

2384. If we exclude it from the sulphuric acid we can also exclude it from the soda?—Yes.

2385. What other source of arsenic could there be in phosphate of soda other than the sulphuric acid and the carbonate of soda?—I think practically none.

2386. In that way, therefore if it were required we could free the phosphate of soda from even the last traces, or almost the last traces, of arsenic acid?—Yes.

2387. I should like to gather from you what other articles of food other than those which are prepared by the intervention of oil of vitriol there are which could contain arsenic acid or arsenious compounds generally?—I think it is difficult to run over everything; but the other sources, I think, are negligible.

2388. Do you mean they are not at all a matter of serious moment?—I think not.

2389. So that if steps could be taken to exclude arsenic from the oil of vitriol practically we should abolish the greater portion of the danger?—Yes; you would not get it in the hydrochloric acid.

2390. Which is an incidental product, in the same way, of sulphuric acid?—Yes.

2391. In fact, it is the arsenic from the pyrites which is practically the origin of the large portion of arsenic which is found in sulphuric acid and sulphuric acid derivatives?—Yes, and that need not involve the abolition of pyritic acid, because pyritic acid can be freed from arsenic and rendered quite as free as sulphuric acid made direct from brimstone.

De-arsenicated pyritic acid may be as free from arsenic as brimstone acid.

2392. Are you conversant with the mode of manufacture of oil of vitriol on a large scale?—I have visited works. I do not advise any works, but I visit them from time to time. I spent a whole day last week in a vitriol works.

2393. Are you familiar with the technology?—Fairly well.

2394. The arsenious oxide in the oil of vitriol comes, of course, from the double sulphide and arsenide of iron present in the pyrites?—Yes.

2395. When the pyrites is roasted in the kiln the arsenious oxide is volatilised?—Yes.

2396. Is there any process known to you by which the greater portion of that arsenious oxide can be taken out before it gets into the vitriol chamber?—You are speaking of the ordinary processes?

2397. Yes?—Yes. A great deal of it may be taken out. In the Glover tower it is practically all taken out.

2398. Before it even gets to the Glover tower, is it Synthetic not known to you that at all events the greater portion sulphuric of the arsenious oxide may be removed?—Yes, a great deal.

deal is deposited in the flues, of course, and in the synthetic acid it is the essence of the process that all the arsenic should be taken out. You are acquainted, of course, with the process employed here and in Germany, that in the preparation of synthetic acid the sulphur is converted into tri-oxide, and that is dissolved in water, and the di-oxide being converted into the tri-oxide by passing it with air over finely divided platinum, if the di-oxide is not entirely deprived of arsenic before it passes over the platinum, the process is vitiated by the platinum becoming choked with the crystals of arsenious oxide. I have seen it done. The di-oxide is washed and washed until, when you look through perhaps 8 or 10 ft. of the gas, with either an electric or bright burner, as long as the atmosphere above the wash water blurs the flame in the slightest it is not free from suspended particles of arsenic. In one works in the neighbourhood of London I suppose they make 500 or 600 tons of this synthetic acid every week, and of course they make other acid.

2399. (Chairman.) Is that from pyrites or from sulphur?—It is made from pyrites or from sulphur, but I think mostly from pyrites. But even in the old process of the chamber acid the greater part of the arsenic is got rid of before the acid reaches the chamber.

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Dr. T. Stevenson. 2399* (*Professor Thorpe*.) You mean it ought to be 1—Yes, it ought to be.

13 Mar. 1901. 2400. That merely means, therefore, that if the vitriol maker would simply prolong the flue through which the gases pass on their way to the leaden chamber or to the Glover tower, he would greatly minimise the chances of any large quantity of arsenic getting into the acid?—Yes.

Construction of flues in sulphuric acid works. 2401. Are you aware of any place where this prolongation of the flue to get rid of the arsenic is practised?—No. I do not know where excessively long flues are used.

2402. Do you know that it is one mark of distinction between the Continental method of making oil of vitriol and the English method that on the Continent the sulphur di-oxide, before it enters into the leaden chamber or the Glover tower, is caused to pass through a flue atmospherically cooled, which leads to the deposition of the greater quantity of the arsenious oxide?—I have understood that is the case, but I have never seen any foreign manufactories.

2403. Do you know this book by Lunge on "Sulphuric Acid and Alkalies"?—Yes.

2404. Are you familiar with it?—I cannot say I am familiar with all the pages of it, but I know a good deal of it. The technology I am not an expert in except generally in the way I have indicated.

2405. In the manufacture of oil of vitriol, for example, in Saxony, where an extremely arsenical pyrites has to be employed, the sulphur di-oxide, on its way to the chamber passes through a flue, and the degree of condensation of the arsenious oxide is so great that upwards of 94 per cent. of the total amount of arsenious oxide present is condensed?—I was not aware of the exact facts, but I knew it was done. A very large proportion is taken out in that way.

2406. Why do you suppose an English maker delivers his gas straight into his vitriol chamber or into the Glover tower without this intermediate cooling through the flue?—I suppose it is cheaper probably.

2407. Why is it cheaper?—A long flue and cooling process must, I suppose, cost more than a short flue.

2408. What he seeks to get is the economy of the heat in the hot gases he is using?—Yes, of course the heated gases may be used as in the Glover tower for concentrating his acid. He does not want to lose his heat.

2409. The point I want to come to is this: Speaking generally, supposing some pressure were brought to bear upon oil of vitriol makers who use or make pyrites acid to cool their gas, we should have very much less arsenic entering into manures and all sorts of other products than now obtains?—Yes.

Individual susceptibility to arsenic. 2410. Have you anything to tell us with regard to the susceptibility of individuals?—I should like to say with regard to the susceptibility of individuals to arsenic, that it varies greatly.

2411. (*Sir William Hart-Dyke*.) Between the sexes or individual members of either sex?—Individual members of either sex. By far the larger number, I think, can bear 8 minim doses of liquor arsenicalis three times a day—that is the ordinary form in which it is given medicinally—for several weeks, without the super-vention of toxic symptoms, that is, a dose of '22 grains of arsenious oxide per diem. A few people can tolerate only a fraction of that amount. Exceptional persons are met with in whom a fraction of the amount produces distressing symptoms, and it has to be suspended. They get irritation of the eyes, rashes and so on. But this idiosyncrasy is observed with regard to many other drugs, chloral hydrate—for instance, a couple of grains, that is, a 10th part of an ordinary dose, may produce symptoms—opium, mercury, potassium iodide, and so on. And even we observe the same idiosyncrasy or susceptibility with regard to articles of food, such as onions, ginger—I know a person in whom ginger produces distressing symptoms—bananas, shell-fish, pork, and honey. In laying down restrictions as to arsenic in food, if such should be laid down, the idiosyncrasy of persons with respect to it cannot be fully met.

cannot be fully met.

2412. (*Dr. Whitelegge*.) Do you mean that it is commercially impracticable to meet it, or that it is not important to meet it?—I think you cannot.

2413. Let us take the case of beer. Do you think that the presence of some kind of arsenic is practically inevitable?—Yes. Occasionally you will find it. I am not speaking of important amounts of arsenic, but

when you come to find, as we do, that there is a quantity which we estimate, say, at the 200th of a grain, or less than that, I do not think such quantities are important, and I think occasionally you will meet with this in beer prepared with great care.

2414. Do you think that great care ought to be exercised to keep out arsenic as completely as possible?—Certainly.

2415. I anticipated your answer, but from your *précis*, I see you are about to give us 1-20th of a grain as a safe quantity. You would not consider it was immaterial whether the arsenic approached 1-20th or whether it did not?—I think it is important to keep out all you can, but I think that the great majority of persons, if they took 1-20th of a grain per diem, would not suffer. But some would, perhaps.

2416. (*Chairman*.) Should not there be protection for the more than ordinarily susceptible people? A large number of people would be injured by 1-20th of a grain of arsenic per day, would they not?—Yes. But what I mean is that there are some people so susceptible to such minute quantities that I do not think you can entirely protect them. I think that with regard to beer and all other articles of food, the provision as to freedom from arsenic should be carried to the utmost limit.

2417. (*Dr. Whitelegge*.) But you think that no grave public danger would arise from any trace of arsenic being present? I understood you to say that in the case of beer, and presumably other foods, every practicable precautions should be taken to keep out arsenic as completely as possible?—Certainly.

2418. But do you suggest with regard to beer, that as long as the accidental quantity present does not amount to more than 1-20th of a grain, no great public danger would arise?—If a person does not take more than 1-20th of a grain per diem, I think you would have very few cases.

2419. But there would be some even then?—Probably there would be some, because it is quite likely that some of the cases of alcoholic neuritis which we have observed during the last few years may be due to beer containing small quantities of arsenic. My own experience teaches me that it is quite common in some districts of England to find arsenic even in modern hon beers, beer prepared with ordinary care, and the presumption is that these beers have been drunk for some considerable time, probably for years, without it being suspected that they were arsenical.

2420. Do you mean that there have been many cases of peripheral neuritis due to such beers?—There have been cases, but in proportion to the population very few, and nearly invariably in persons addicted to taking large quantities of beer.

2421. (*Sir William Church*.) One witness suggested to us that what we have hitherto called alcoholic neuritis is always due to arsenic. Would you go as far as that?—No; I do not agree. I discussed that matter with Dr. Reynolds—I presume you refer to him—and I think it is an unproved hypothesis. That beer drinkers are more prone to neuritis than spirit drinkers I think would be endorsed by the medical profession generally.

2422. Now?—Yes; and would have been before this epidemic, I think.

2423. Were not the original cases of alcoholic neuritis rather in mixed drinkers than in beer drinkers?—Yes; we used to suppose that.

2424. I think Sir Samuel Wilks' original cases were supposed to be spirit drinkers?—Yes; and now we have come round to beer drinkers.

2425. I suppose most of the spirit drinkers drink beer too?—Yes; I have examined, since this epidemic, in a hospital I am attached to—Guy's Hospital—several cases of alcoholic neuritis. There have been very few, and I have at least tried to see every case. There were only three or four, and there was nothing whatever to indicate to me that it was arsenical neuritis. They had no pigmentation, none of the appearances of the eyes, none of the rashes, in fact, nothing to suggest that it was arsenical. I am not much of a clinical physician now-a-days, but so far as I know, there is such a thing as alcoholic neuritis and such a thing as arsenical neuritis. In fact, we have neuritis from other forms of metallic poisoning than arsenic, lead, for instance.

2426. But still, granting there is such a thing as

Dr. T. Stevenson. 13 Mar. Excludes minute quantities of arsenic from food—practicability.

Alcoholic neuritis for the epidemic relation to arsenic.

alcoholic neuritis, arsenical neuritis simulates it much more closely than does lead?—Yes.

2427. And more closely than diphtheritic paralysis?—Yes; because there are other symptoms which guide you to a diagnosis.

2428. (Chairman.) What do you say as to the cumulative action of arsenic?—The term cumulative or accumulative can be only, I think, a relative term. All poisons are in a sense cumulative. Even rapidly excreted alkaloids, such as strychnine, show a cumulative action when small safe doses are given at too brief intervals—that is, before the major portion of the previous dose has been excreted. I have seen many cases of strychnine given in small doses, and when a patient has taken a certain number of doses the strychnine spasm comes on, no doubt due to the cumulative action of the strychnine. I believe that arsenic is no more cumulative than many other poisons which are rapidly excreted. There are poisons, of course, which are only slowly excreted, and distinctly cumulative poisons, lead for instance. The patient may take a fraction of a grain of lead per diem in an article of food or drink, and dies eventually from lead poisoning, and you will find several grains of lead in his body, in his liver especially, the accumulation of many days. I know of no observation of a similar character with regard to arsenic. Even in the acute cases I have only once found more than half a grain in the liver. More commonly after a death from acute arsenical poisoning you will find a half or three quarters of a grain. When arsenic is given in repeated small doses, either tolerance is established, as in the rare cases of the arsenic eaters, almost unknown in this country; or what I may term the input or the output of the drug are balanced before a fatal dose accumulates in the body. That is probably what occurs in the majority of cases where arsenic is given medicinally without producing toxic results. Or again, the toxic amount is reached in the body before the point at which input and output are balanced. I may illustrate it in this way: If the daily dose be 0.22 of a grain, and we assume that one-fifth of the absorbed amount—I am not speaking of that remaining in the intestinal tract, but the absorbed arsenic is excreted daily—when there is 0.9 of a grain in the body the input and the output would be balanced; that is to say, 9-10ths of a grain would be in the body on a certain morning, and to give a patient the ordinary dose, .22 would bring it up to 1.12. He excretes 1.5th of that amount during the day, and you will observe that the input and the output become balanced. He takes about a fortnight to arrive at that.

2429. (Dr. Whitelegge.) That hinges on the assumption of the 1.5th elimination?—Yes.

2430. Is that based on any data, or is it merely an illustration?—Merely an illustration. If you take it, on the other hand, that 1-10th only is excreted, the same condition will be arrived at in about three weeks, but the body will then contain about 2 grains, which is a fatal dose. Certainly, from the observation of the amount of arsenic excreted in the urine, I do not think that the excretion would give less than 1-10th of the amount taken.

2431. Of the amount present in the body?—Yes.

2432. The amount taken would be different?—Yes.

2433. In whatever combination or locality?—Yes, it is excreted very rapidly at first, at least in relatively large amounts, and then it gradually tails off.

2434. You gave us some instances in which it was found two months after ceasing to take the arsenicated beer, did you not?—Yes; in that case there must have been some small portion retained. Others have found it often after longer periods in very minute quantities.

2435. Why do you adopt 1.5th and 1-10th as illustrations? I presume you regard them as approximately correct?—Partly for this reason, if you give arsenic to a person you cease to detect it in the urine generally within a fortnight or three weeks. The quantity after that period is in any case almost infinitesimal.

2436. And in the tissues of a person you would not be able to take that amount into account?—No; but when you take it into account 14 days after death it is very small. 1-70th of a grain, I think, has been found 14 days after taking arsenic. If you cease giving arsenic on my assumption of 1.5th or 1-10th it disappears from the body in the same time that it took to raise it to that point. That is mathematically correct, I believe.

2437. Is that so? If 1.5th or 1-10th of the residual store in the body disappears in the course of each day, it

would gradually reduce the amount of arsenic eliminated every day, and it might take an indefinite time to reduce the amount?—It would theoretically take an indefinite time, but it would be practically reduced to zero in the same time that it took to raise it to the amount.

2438. (Sir William Church.) That is to say, as recoverable in the excretions and the urine?—I am speaking theoretically.

2439. (Dr. Whitelegge.) If it takes an infinite time, as I thought we agreed, to eliminate by that process of 1.5th of the residual store being removed daily, and taking also your other proposition that it takes the same time to eliminate that it takes to enter into the system, would not that mean that you must be taking the dose of arsenic for an indefinite period?—Yes, it would theoretically, of course. But may I just illustrate it in this way. Suppose you give a daily dose of .22 of a grain, I have been calculating out the amount which would be present at the end of each day, the amount added on each day, and the amount excreted each day. The amount reaches in 21 days 1.96 grains, that is theoretically the total amount which would be present. Then I suppose that that arsenic ceases to be given, and in 21 days it is reduced to .02 of a grain in the whole body.

2440. Is that on the basis of a constant daily elimination of equal amount?—No, a constant fraction of the amount in the body. It is obvious that if you give a certain amount, and say 1-10th of a grain is excreted per diem, you very quickly get the whole of the arsenic out of the body.

2441. But your suggestion is that the quantity is not 1-10th, or any other fixed amount, per diem, but always amounted to 1.5th or 1-10th of the remaining arsenic; 1-10th or 1.5th of the whole amount in the body?—Yes. I am assuming that when you give the arsenic, 1.5th or 1-10th of the whole amount in the body goes out per diem, and in the 14 or 21 days, according to the excretion, or the fraction of excretion, you get the amount in the body constant; and then I assume that you cut off the arsenic altogether, and in a corresponding period practically the whole of the arsenic disappears.

2442. (Chairman.) If it disappears at the rate of 1.5th of the quantity given out per day, it would be very quickly all gone?—Yes.

2443. 1.5th is 20 per cent. It is the compound interest principle. In eight or ten days there would be quite an imperceptible quantity left?—Yes, theoretically. It would practically all disappear in 14 days.

2444. (Dr. Whitelegge.) I am afraid I do not follow, but perhaps I shall see it more clearly in the print of your evidence?—If it is not clear, I should be happy to explain it.

2445. Assuming that 1-10th disappears in a day, you tell us that at the end of a very few weeks it would be reduced to a very small quantity, which I should not have anticipated as I understand the matter.

2446. (Chairman.) It is just the principle of compound interest. If a person loses his property at the rate of 5 per cent. per annum, you can easily tell how much he will have after twenty years?—Assuming that you have arrived at a stage at which the body contains .88 of a grain of arsenic, and you give no more, in a week it will be reduced from .88 to .14 and in another week it would have practically disappeared.

2447. It depends on the hypothesis of the quantity disappearing bearing a fixed proportion to the quantity that is in?—Yes.

2448. Your calculation is perfectly correct there, Elimination but whether the assumption on which you found it is of a single true or not must be a matter of observation or guessing large dose. as to what is probable?—Yes; I brought forward that illustration, because if you give arsenic to a person, say one dose, you will find a considerable quantity the first day and it rapidly diminishes day by day, until in from seven to twenty-one days it all disappears. If it were not rapidly excreted the amount which would accumulate in the body would very quickly far exceed a lethal dose.

2449. Do you reckon a lethal dose the total quantity that may be in the body at any time?—I mean the quantity which has actually destroyed the life of a human being.

2450. 2 grains of arsenic in one dose would destroy the life?—Yes.

2451. Does it follow from that that there might be 2 grains of arsenic in the body, and yet that it might be quite innocuous?—We know that there are arsenia

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Individual susceptibility to arsenic. 2452. (*Sir William Church.*) Do you know the largest dose anyone has taken with impunity for any length of time?—I have heard of 30-minim doses being given, which is heroic treatment.

2453. How many times in the 24 hours?—Two or three times.

2454. (*Chairman.*) Of Fowler's solution?—Yes; 30 minims at once; over a quarter of a grain.

2455. That would be a quarter of a grain a day?—That is given twice or three times a day, but I do not think the majority of people would bear that quantity.

2456. In that way in four days 3 grains of arsenic would be taken into the system?—Yes.

2457. And some of it would have perhaps disappeared?—Yes.

2458. Your statement is that 8 minims three times a day is a full dose?—I think that is the ordinary full dose you give to out-patients.

2459. It means a little more than 1-5th of a grain per day?—Yes. It is the maximum pharmacopœia dose. I particularly enquired for the dose of the Manchester physicians, and the largest dose I heard they had been given was 30 minims, a quantity which *Sir William Church* has given, but I find it was common to out-patients to begin and continue 8-minim doses.

2460. (*Sir William Church.*) I do not think that is common in London?—I do not think so either. I was rather surprised to find the amount was so large. I should have thought four or five minims to begin with, and then rise to eight, was the usual thing.

2461. (*Dr. Whitelegge.*) What is the smallest amount of arsenic that has been found to prove harmful in medico-legal investigations—one dose or repeated doses? I am thinking of chronic arsenical poisoning?—I have known $\frac{1}{2}$ of a grain bring a person within an ace of her death.

2462. That you would consider an acute case?—Yes.

2463. There are no figures you can give to us about chronic arsenical poisoning, are there?—No, except exceptional cases. I think *Dr. Dixon Mann* will tell you about a servant of a friend of his to whom he gave a 5 minim dose of liquor arsenicalis, which would be equal to something less than 1-20th of a grain, three times a day, and she had arsenical rashes on the second day. But that is an exceptional case. I think one of the Americans says that the smallest dose which has produced decidedly poisonous symptoms was about something less than half a grain given in divided doses for several days.

2464. (*Chairman.*) Half a grain per day for several days?—No, half a grain in total. But that is very exceptional.

2465. (*Dr. Whitelegge.*) The arsenical poisoning we have under consideration in connection with this epidemic is one of very small doses, is it not?—I do not know. We do not know how much the beer contained which most of them drank, and how much they drank. I know in going round the Crumpsall Infirmary I asked each patient how much they took, and they would say, "How can we tell you, doctor? Anything we could get." One man, a man out of work, admitted 15 pints a day, which is nearly two gallons. That was his usual tipple.

Heavy drinkers affected by the epidemic. 2466. (*Chairman.*) That is within a pint of two gallons?—I have not seen the case myself, but I know a brewer's man in the Liverpool district where the beer contained on analysis of two samples 1-7th and 1-6th of a grain per pint respectively per gallon, and he drank usually, he said, two gallons per diem.

2467. Six pints, therefore, will contain a grain of arsenic?—Yes. He took, according to his own account, assuming the beer when he began to suffer contained the same amount, two grains of arsenic per day.

2468. Was he poisoned on the first day?—No.

2469. Did he get very ill on the first day?—No; he suffered from neuritis after drinking the beer for some time. Then you must remember that the man who drinks that large quantity also must excrete a large amount of urine, and as arsenic is chiefly excreted by the urine the presumption is that it very quickly ran through

him. The arsenic must have been in a very limited condition.

2470. (*Sir William Church.*) It is also probable, is it not, that the beer did not always contain that amount of arsenic?—It is probable it did not. When he was ill, a former assistant of mine examined the beer, and I saw the results of two samples of beer taken on two separate occasions. One was $\cdot 14$, and the other $\cdot 17$ of a grain per pint.

2471. One-sixth of a grain per pint is one and a-half grains per gallon, and that $\cdot 17$ of a grain per pint is one and a-third grains per gallon?—Yes. It must be taken into consideration with regard to this epidemic that the beer was only taken at that one particular time, and it is quite a matter of speculation whether the beer always contained as much, or less, or more than on those particular days when *Mr. Groves* and others stopped the beer. The beer that had been brewed two or three months before would be all consumed, as these light ales are consumed within a fortnight of their being brewed, very often.

2472. How many specimens of beer have shown so large a proportion of arsenic as that?—I do not know. I did not myself analyse any of these highly arsenicated beers in Manchester, but I should have thought you had evidence that they did contain, some of them, over a grain per gallon.

2473. (*Sir William Church.*) One and a-half grains. Practically that was the amount found in the case I have mentioned.

2474. (*Chairman.*) We have not heard of as much as Ma two grains per gallon, but we have heard of as much as one and a-half grains per gallon in Liverpool. You give us in one case one and a-third grains, and in another one and a-half grains per gallon?—Yes.

2475. Have you anything to say about the detection of arsenic in beer and its quantitative determination?—There are three tests commonly employed for the detection of arsenic when mixed with organic matter in small amounts, and they have been employed for estimating its amount. The results thus obtained are, however, estimates only, good approximations at the best, and not reliable absolute determinations of amounts. In beer, with a limited amount of material, say, one-third of a quart—which has been a very usual amount to be sent to the public analyst—and the arsenic present in the proportion of a few hundredths, or even tenths of a grain per gallon, absolute and accurate determinations of the quantity of arsenic present are impossible, and approximate estimates only can be made. When present in the proportion of a grain and upwards per gallon, the arsenic may, however, be separated as a weighable sulphide. The tests referred to are *Gutzeit's*, *Reinsch's*, and *Marsh's* tests. *Gutzeit's* test, based upon the liberation of arsenetted hydrogen, and the yellow colour produced by the action of this gas upon mercuric chloride, is delicate, subject to the same limitations as *Marsh's* test, and may mislead, since other substances besides arsenetted hydrogen strike a yellow colour with mercuric chloride. Unfortunately, when the colour is produced the test cannot be pushed further for confirmation that the yellow colour is due to arsenic. *Marsh's* well-known test in its modern modified form is very delicate, except in the presence of some sulphur compounds. It needs great care and much time, skill, and experience to work it successfully, and avoid error; and it is troublesome for beers. It should, however, be used where estimates of minute amounts of arsenic are needed, and by way of confirmation. *Reinsch's* test is about as delicate as *Marsh's* test, is easier to perform, more rapid, less liable to error, and more reliable than the other two tests mentioned. It succeeds where the other tests may fail, that is, in the presence of sulphur compounds. It succeeds when you have present the yellow sulphide of arsenic. It is not a quantitative test, but may be used to ascertain whether arsenic is present or absent in more than a given small proportion, and roughly an estimate of quantity must be made from its result. It is applicable with care when the arsenic is present in the form of its higher oxide—the arseniates—when properly applied, but these are, perhaps, never found in beer—at all events as accidental contamination. By it (as also by *Marsh's* test) the arsenic may be obtained in visible crystals, and these may be subjected to further confirmatory tests. The reasons why *Reinsch's* test was recommended by the *Brewers' Commission* were these:—We found that *Marsh's* test, which was being generally used in Manchester, was giving much trouble; that beers brewed in fresh, cleansed apparatus, and partly from arsenic—free sugar, and even all malt and hops, often contained

arsenic; that it was desirable to use a simple test by which each gyle of beer, and even each barrel of beer could be readily tested; and that provisionally a limit might be set to the quantity of arsenic in safe beers. Those were the immediate problems before us, and we had to advise of Dr. Miller and the chemists working under him for the brewers as to what was advisable under the circumstances. We put this limit provisionally in conference with Dr. Delepine, Dr. Coutts, and others, at 1 per million of arsenious oxide—0·07 grain per gallon—or 1·14th grain per gallon. The now well-known test was eventually laid down in a form to meet these wants, for the use of the brewers' chemists, so that these might readily separate beers into two classes—those containing less than 1 per million of arsenic which might be passed into commerce, and those which ought to be rejected, or subjected to further analysis. The test has succeeded admirably, and in reality causes the rejected of beers containing more than one part of arsenic per two million of beer—about 1·30th grain per gallon; and in skilled hands its delicacy is even very much greater than this. I have in no case found arsenic by Marsh's test in beer where I have not also found it by Reinsch's. Using this test, I find that by far the larger proportion of beers sold in London and the southern counties are arsenic-free; but that beers sold in several parts of the kingdom contain small quantities of arsenic—generally proportions which would not, as I believe, prove injurious to health. I may mention 1·200th of a grain, 1·100th of a grain, or 1·50th of a grain, or 1·30th of a grain per gallon. It was the discovery that some beers—even all malt beers—contain small quantities of arsenic that led us to investigate brewing materials generally; and this investigation is not completed. It involves the examination of hops, malt, grain, yeast, coal, coke, etc. It is now easy to obtain brewing sugars free from arsenic; it is not, however, so easy to obtain arsenic-free malts. This subject we are working at. I have examined large numbers of jams and sweetmeats—generally made, I believe, with imported glucose—for arsenic, but in no case have I found any arsenic.

2476. (Sir William Church.) I should like you to tell us about what numbers of these jams and sweetmeats you examined?—I think I can give it to you approximately.

2477. Were they obtained in London or in the country generally?—In London and the southern counties. In January and February last I examined 59 samples of jams and sweetmeats and marmalades, not a very large number.

2478. Could you tell us at all what food substances are likely to be contaminated with arsenic? You have had great experience, and I should like to know whether you have ever found any food substances contaminated with arsenic?—In cases where sulphuric acid is used you may find it, but I do not find it in any food stuffs practically, that is, in an appreciable amount. If one takes huge quantities of material, one may get a very minute trace of arsenic, but if you take any reasonable quantity, say four ounces of sweets and so on, you are generally not able to detect any arsenic. I have, in years gone by, found it in sweets which have been coloured, but of late years I have found none.

2479. Have you found arsenic in syrups which are used for making temperance drinks?—No; I have examined a good many syrups of late, but I have not found any arsenic in them.

2480. Or in effervescing drinks made with kalis and tartaric acid?—I have not examined any for a long time. Sometimes I have found a little lead in them. The quantity of arsenic present in those must be very minute, but, of course, they are subjected to the same accidents as glucose. There is, however, this difference, I believe: I am told that those things are chiefly made with foreign glucose, and we know, from old experiments made 25 or 30 years ago, that the glucoses then were very impure as compared with the present day. They did occasionally contain arsenic, but in late years we have entirely lost sight of it.

2481. Have you examined imported glucose?—No; I did not undertake any part of that investigation.

2482. (Professor Thorpe.) Did you have reason to believe the sweets you examined, the confectionery and the jams, were made with imported glucose?—All I know is that I am told that the imported glucoses are chiefly employed, but I do not know that of my own knowledge.

2483. Do you know anything about the colouring

matters which are used in connection with confectionery, whether they are liable to contain arsenic?—I have not found it in them.

2484. Do you know that the vendors of such articles usually obtain guarantees from the manufacturers that they are free from arsenic or other deleterious products?—Yes; they employ a skilled chemist to advise them on those matters. I have had it alleged in cases of death that it was from the coloured sweets children had eaten, but I found no arsenic, and when I administered the colouring matter in large quantities to animals, I found it as a rule innocuous. Of course, there are certain colours which are injurious.

2485. I think we may summarise what you have told us in this way, that you are of opinion that this outbreak of arsenical poisoning is to be entirely attributed to beer, to beer which has been made from glucose, itself made by means of sulphuric acid containing arsenic?—Yes.

2486. Are you of opinion that the outbreak is practically wholly to be attributed to that cause?—I know of no other cause.

2487. Are you also of opinion that there is no reason to suppose that other forms of food or drinks contain arsenic in quantities to alarm the public mind?—I am of that opinion.

2488. (Dr. Whitelegge.) Would there not be the same risk as regards other articles of food into which glucose enters?—Yes.

2489. Do you regard the recent epidemic as an accident?—Yes.

2490. Which accident might have happened to glucose destined for other consumption than that of beer?—Yes; I think I may say that those connected with food products, beer, and so on, have relied on the fact that every glucose manufacturer—and I think there are only 10 or 11 in this country—employed skilled assistance and skilled advice.

2491. But one did not, we gather?—The advice was not effectual. He was supposed to have employed it. I do not attend to apportion any amount of blame, but there was a lack of scientific supervision there.

2492. The expert committee's test was intended as a provisional measure, was it not?—Yes.

2493. Am I right in supposing that the degree of delicacy that has been assigned to it, first as showing one part in a million, and latterly as showing still more minute fractions, depends on the amount of liquid taken—that if the amount of beer were doubled it would be twice as delicate?—No, I do not think it would.

2494. Not even if evaporated down?—No. With regard to the application of that test, when we evaporate large quantities down we introduce a difficulty in the way of manipulation. But I know that if you take 1·100th of a grain, and add it to beer, and operate on 200 cubic centimetres you may at once detect it.

2495. Assuming for the sake of argument that arsenic were present in beer in the form of arsenious acid, would this test reveal its presence?—Yes. If you have sufficient acid. That is where it usually fails. You want sufficient acid, and long boiling.

2496. (Chairman.) Sufficient hydrochloric acid?—Yes.

2497. And how long boiling?—We employed 45 minutes. If you employ 10 minutes or a quarter of an hour, and you have arsenic acid present, you fail to detect it.

2498. Will three-quarters of an hour's boiling deposit all the arsenic on the copper?—I cannot say. It does not take all of it out, but it does take a sufficient quantity to enable you to detect it easily. I might explain that the reduction of the arsenate depends on the presence of some reducing agent: generally it is a trace of sub-chloride of copper dissolved by the hydrochloric acid used. You must have some reducing agent present. It might be that in beers the sugars exercise a reducing effect.

2499. If you used a sufficient quantity and boil it for a long time?—You do not boil it down much.

2500. It would be too difficult for practical purposes except in rare cases; but still it would not be possible to boil down two or three gallons of beer to quite a small quantity, say, a quarter of a pint. It would be a long process perhaps?—You get it exceedingly syrupy, and then you get charring.

2501. Would there be a difficulty in getting the whole arsenic out by some proper chemical test, supposing it is syrupy, thick, and all the arsenic remaining in it?—You

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Arsenical
beer solely
responsible
for the
epidemic.

Expert com-
mittee's test.

A small
glass

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Quantitative
determina-
tion of
minute
quantities of
arsenic in
beer

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must oxidise the organic matter and get it clear, and then you must employ Marsh's test or precipitation as the sulphide; but when you have very minute quantities of arsenic the sulphide, although insoluble, is sufficiently soluble to prevent the formation of precipitate when you have minute fractions of a milligramme present.

2502. But supposing you push it to the very utmost, and boil it down until it is dry, and then char it, you could volatilise the whole arsenic out of it, could not you?—You can by distilling that char with hydrochloric acid.

2503. So that there is no impossibility in taking a large quantity and finding all the arsenic in it?—No, by distilling it with hydrochloric acid.

2504. It is a difficult process, but within the reach of chemical skill?—Yes.

2505. To get the whole of the arsenic in four or five gallons of beer?—Yes; but when you remember that we were advising the brewers as to how they should test their product such a test was out of the question.

2506. I quite understand. I think Dr. Whitelegge spoke of the boiling, and I wanted just to make sure that boiling down would succeed to any extent; but it is obvious that it is not a method practicable in ordinary work?—Yes.

2507. (Professor Thorpe.) I think Dr. Stevenson thought he was asked in reference to the process he was describing.—(To Chairman.) I think you yourself wished to know whether it would be possible after boiling down beer to get arsenic out by some process.

(Witness.) May I say in answer to that, that of course you can boil down beer, get a solid residue, distil that with hydrochloric acid, and get the whole arsenic in your distillate. Then with Marsh's test you may get it out, or if it is present in a larger proportion, you may precipitate it as a sulphide and weigh it, but you must have something beyond a small amount to get the sulphide.

2508. (Chairman.) That would be a way of finding whether there is as much as 1-200th of a grain per gallon?—Then you would have to use Marsh's test.

2509. But you could do it?—Yes. If you have to separate 1-200th of a grain by boiling down and distilling, and precipitating, you have such a volume of liquid that you would not be able to get the precipitate down or collected.

2510. It would be almost impracticable, but if the research was needed to test beer to the very utmost it could be done?—Yes.

2511. There is the question of how much is due to arsenic in malt. You have said it is now easy to obtain brewing sugars free from arsenic, but it is not so easy to obtain arsenic-free malts. Can you tell us how much arsenic per gallon has gone into beer through the malt alone?—Not from my own experiments; but I know that Dr. Miller, who has carried out the experiments, has found as much as 1-40th of a grain of arsenic per pound of malt.

2512. How much would that give to the gallon of beer?—If it was brewed altogether from malt it would give 2 and 1-3rd times that. Multiply 1-40th by 2 and 1-3rd, and you will get the amount in the beer, 2 1-3rd pounds of malt being used for a gallon of beer. That is beer of the standard gravity. It would be something like 1-15th of a grain in a gallon.

2513. (Sir William Church.) We have also had information that in the process of brewing there is a waste of arsenic; that is to say, you do not find the calculated amount in the finished beer that you should have from what is in the ingredients?—The amount in the sulphuric acid does not go into the sugar, the char and other processes taking it out. In the process of brewing undoubtedly the yeast has a selective power for arsenic, and the yeast, as the brewers will tell you, acts as a gauge for the beer. It appears to take up the arsenic

in appreciable amounts, and to purify the beer. And then the yeast employed for brewing other beers communicates the arsenic to them, but in a very diminished amount.

2514. (Chairman.) Do you think such yeasts being sold to bakers is a source of danger in respect to the bread?—I think not.

2515. The quantity of arsenic in the yeast would be so small used for bread that it would not give any appreciable quantity?—I think Dr. Niven—probably you have had his evidence—had a great many breads examined early on in the epidemic, and I don't think he found any appreciable quantity of arsenic in them. That is what I should expect.

2516. We have seen the great difficulty of detecting small quantities in the finished beer. If the substances put into the beer are separately examined could we keep out arsenic, or put only a very small quantity into the beer?—Yes.

2517. Supposing we have performed practical tests on the malt and the hops and the yeast and the brewing sugar, if any is used, then can we be sure that there will be less than 1-100th of a grain per gallon in the beer?—I should not like to pledge myself to 1-100th of a grain, but it would be very small. I should think that probably you might bring it to double that amount—1-50.

2518. Could you bring it to a smaller amount than is perceptible by the most delicate use of the Reinsch test?—No; I can detect 1-50 of a grain per gallon by the Reinsch test.

2519. (Professor Thorpe.) Do you mean to imply that if you apply the tests severally to the various things, the cumulative effect of having to let slip some quantity of arsenic which was not detected would be that the finished beer would contain as much as 1-100th of a grain?—I did not quite mean that—that if you examined all the things separately; but until malt is made with greater care than it is at present you may get 1-50th of a grain per gallon. When you exclude gas coke especially, and the malt is cleansed, and so on, you may reduce it to a very small amount. By the exclusion of arsenical fuels for drying the malt and by care in preparation you may reduce that to practically nothing; and it is the same with regard to the sugar and the hops, but not much hop is used in each brew, and I do not think hops add any considerable amount. If you examine all those separately, and exclude arsenic, your finished beer will contain—I do not like to pledge myself at present, but I should say not more than 1-50th grain per gallon, and probably less than 1-100th.

2520. (Chairman.) So that we can probably secure that the beer contains less than the smallest quantity perceptible to the Reinsch test?—I do not know.

2521. If you secure the purest materials by practical methods, can we assume that the arsenic would be less than would be shown by the Reinsch test?—I do not know, because the Reinsch test will often discover less than 1-100th of a grain per gallon. I do not like to limit the test.

2522. (Dr. Whitelegge.) Has it been the practice amongst public analysts to look for arsenic in beer prior to the epidemic?—I believe not. I am a public analyst, but unfortunately I had not any beer to examine for months before this epidemic. I should think as a rule they would not. I know they thought this was done under the Excise, who had power, they believed, to stop the use of injurious ingredients.

2523. Do you think that at the present time, and in future, public analysts would examine samples of beer and submit them under the Sale of Food and Drugs Act, for arsenic?—I am sure they would.

2524. As a matter of routine?—Yes.

Arsenic in malt.

Affinity of yeast for arsenic.

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SIXTH DAY.

AT WESTMINSTER PALACE HOTEL.

Friday, 15th March, 1901.

PRESENT:

The Right Hon. LORD KELVIN (in the Chair).

SIR WILLIAM CHURCH

Professor THORPE.

Dr. WHITELEGGE.

Dr. BUCHANAN, *Secretary*.

STATEMENT on behalf of MESSRS. NICHOLSON and COMPANY.

15 Mar. 1901
 (Mr. Simpson.) My lord, may I, on behalf of Messrs. Nicholson and Company, chemical manufacturers, of Leeds, hand to your lordship's Commission a statement which has been prepared? And in doing that, I should like, on their behalf to express their obligation to the Commission for the consideration which has been shown to them, and is proposed to be shown to them, in postponing at any rate some part of their examination. When I say that only on Saturday last we finished a second inquest of something like ten or eleven days, in which their position was subjected to the very severest criticism, your lordship will understand how much they appreciate the consideration that has been shown to them. My lord, I understand that the rule of the Commission is that counsel or solicitors should not appear before you. We do not wish in any way to infringe that rule, but might I suggest that it might be of service at a later period of the Commission, inasmuch as there is a large mass of papers in connection with this matter, which are within my knowledge (having conducted the case on their behalf), that I might be allowed, if it be necessary, simply to attend for the purpose of to some extent assisting my clients and the Royal Commission by the production of any documents, or by giving any other information that might be of service to the Commission.

(Chairman.) Certainly; the Commission will be glad if you will attend on such occasions, and be ready to give information.

(Mr. Simpson.) If your lordship pleases. Then I understand that the arrangement is that this statement should be handed in now on behalf of my clients. If the Commission could see their way to it—although I do not press it strongly on their behalf—to postpone even the public reading of that document until the action with Bostock's has been disposed of, it might be a convenience; because then we should avoid

raising before this Commission any contentious matter as between us and Messrs. Bostock. If the Commission could see their way to do that, to take the statement and not at present to publicly read it, to leave both the statement and its cross-examination over until the Bostock action has been disposed of, when we shall have dealt with all the contentious matter—and this is not a convenient place to deal with that—it might facilitate matters.

(Chairman.) The Commission are willing to receive the statement which you now put in, and to postpone to a suitable time the public reading of it, and the putting of any question upon it that the Commission may desire to put.

(Mr. Simpson.) If your lordship pleases. Then I will put this statement in, and say that my clients feel it their absolute duty to give the Commission every assistance in every way that is possible; and I am very much obliged to your lordship.

(Chairman.) It must be understood that the postponement shall be till a convenient and suitable time. We cannot undertake any indefinite postponement.

(Mr. Simpson.) I should think we should have this action of Bostock disposed of, in the ordinary course of legal procedure, not later than a couple of months hence, and I suppose your Commission will be sitting at any rate until then.

(Chairman.) The Commission, of course, cannot give a pledge to postpone this matter until the final settlement of the Bostock case, but I say we will postpone it until a reasonable and suitable time for reading it occurs and putting questions upon it.

(Mr. Simpson.) We cannot reasonably ask for more than that, my lord, and I am very much obliged to you. (Mr. Joseph Nicholson handed in the statement of his firm referred to by Mr. Simpson.)

Dr. J. TATHAM (of the Registrar-General's Office), called; and Examined.

Dr. Tatham. 2525. (Chairman.) We shall be obliged if you will give us any information that you can give with reference to the recent epidemic; that is, evidence which has been reported to you, and any other points which have come under your notice?—I attend here at your Registrar-General's Office. I can be gleaned from the National Death Register with respect to the mortality from certain causes in England and Wales which are now the subject of enquiry by your Commission. Since receiving your lordship's letter I have had the advantage of perusing the most instructive report on arsenical poisoning recently submitted to the Local Government Board by Dr. Buchanan, and, as a result, I have been able to form an idea as to the kind of information which will be useful to your Commission, on this subject. I should mention that up to the present time neuritis has not been separately classified in the returns of the General Register Office. Multiple or poly-neuritis is classified under the heading of "nervous disease." Arsenical neuritis under the head of "Arsenical Poisoning"; alcoholic neuritis goes to "alcoholism."

2526. So arsenical neuritis is a name of old standing?—Well; it is a name of some considerable standing, but up to the present time it has not been separately classified in the official reports; it has been classed to poisoning by arsenic.

2527. Has there been any difficulty in respect of distinguishing between arsenical neuritis and alcoholic neuritis?—May I explain to your lordship? About the middle of last year, when abstracting the deaths in England and Wales for the year 1899, we noticed a considerable excess of deaths returned under the head of neuritis. This was earlier than the date at which we in London heard of the epidemic of arsenic poisoning in Lancashire.

2528. Perhaps a year earlier?—Not a year, but some months; two or three months, perhaps.

2529. It was in 1899 that your attention was drawn to it?—Yes. The deaths referred to are those occurring in 1899. Towards the end of that year we noticed a considerable excess in the number of deaths reported as

Dr. J. Tatham.

Increase in deaths from neuritis in 1899.

Dr.
J. Tatham.

15 Mar. 1901.

Special
classification
of neuritis
deaths in
1900 in pro-
gress.

from neuritis, and as I say, this was some time before we in London heard that an epidemic of neuritis in connection with arsenic poisoning had occurred in the North of England.

2530. Those deaths were returned simply as neuritis, were they; or were they under the head of alcoholic neuritis?—Some of the cases were referred simply to neuritis, others to alcoholic neuritis. When we came to abstract the deaths for 1900 I made arrangements that the deaths from neuritis should be separately classified in all possible detail. The abstraction of these deaths for 1900 is now in process, and by the end, or shortly after the end, of May I hope to have that process complete. With your permission I will give you particulars with respect to the information which I hope to be able to submit to you shortly after the end of May:—(1) The number of deaths directly attributed to poisoning by arsenic, by lead, and other mineral poisons; (2) The number of deaths definitely ascribed to alcoholism, as well as those frequently found to be associated with intemperance, such as multiple neuritis, hepatic cirrhosis, other affections of the liver, and syncope; (3) The number of cases in which death is ascribed to a combination of any of the above causes. For purposes of comparison, figures will also be submitted showing the mortality from most of the above causes, neuritis excepted, in recent previous years. I hope to be able to present that information to the Commission shortly after the end of May. It is impossible to expedite the process beyond that, because the abstracting of over half a million deaths is a serious matter, and requires very great care.

2531. Then by the end of May the information can be here, you say?—Yes; I hope shortly after the end of May to have the information complete for the Commission.

2532. For what years, 1899 and 1900?—For the year 1900, the year which I think your Commission is enquiring about.

2533. Yes. Then at present there is statistical information in your Department which has been published regarding 1899?—Yes; but you see, the deaths from neuritis were not separately abstracted in that year, and consequently I cannot give you any information concerning them.

2534. But the information already published by your office regarding 1899 would indicate the increase that you tell us you have noticed?—No.

2535. The increase of neuritis cases?—Unfortunately not, because neuritis was not separately abstracted as a cause of death; it was included under the head of "nervous disease." But deaths from arsenical poisoning unquestionably will be indicated in the reports for 1899, and also those ascribed to intemperance.

2536. According to your recollection, was there an increase of arsenical poisoning in 1899?—I have not the figures before me, but I shall prepare them in due course.

2537. As to deaths from alcoholic poisoning in 1899, have you any recollection whether there was any augmentation in that respect?—I shall shortly have the whole of the figures for that year.

2538. (Dr. Whitelegge.) Would it be possible to give the figures, when they are completed, in quarters?—Yes, certainly; and also to give the particulars for

various parts of the country, both of which I think will be useful to you.

2539. (Chairman.) The Commission is very anxious to know whether or not that which came to such a disastrous head in 1900 may have been going on to a less degree in previous years, and the valuable information collected in your statistical department may perhaps throw some light on that question, because for the public health it is obviously very important indeed to know whether such a commodity as beer, for instance, has, though unknown, been occasionally a source of arsenical poisoning, or of neuritis due to arsenic. Perhaps you would kindly bear that in mind. Anything that your office can give us in the way of help towards such knowledge will be highly valued;—I will do my best.

2540. (Sir William Church.) Can you say when the term "neuritis" was first introduced into your tables?—Unfortunately, it has not been introduced, up to the present time; we have published no figures with respect to neuritis at all.

2541. Not under the class of "nervous disease"?—Simply as one disease among many, under the class of "nervous disease," unless it is due to alcoholic neuritis, and then it would go to "alcoholism." In the case of arsenical neuritis, the death would be classed to "arsenical poisoning." But I have taken care with respect to the year 1900 to take out all those deaths under separate headings.

2542. But even the term "alcoholic neuritis" was not used, you think, in your mortality tables before the year 1886?—It has never been used in them. In the return which I am about to prepare I shall distinguish between the several forms of neuritis.

2543. (Chairman.) But you say alcoholic neuritis has been in use in 1900?—Not in our returns: it is a new heading.

2544. So there is no heading of "alcoholic neuritis" prior to 1900?—No.

2545. But in the death certificates alcoholic neuritis is one of the designations which has been used?—Yes.

2546. But that does not appear in your statistics?—No.

2547. (Sir William Church.) Could you give us an idea how long that term has been made use of in the death certificates?—As you know, Sir William, it is come a term which has been more frequently used during recent years than it used to be.

2548. And therefore there is not any very great object to be gained by going back too many years?—I think not; and it would be a very troublesome and expensive process.

2549. And probably misleading?—I fear that it would. I am convinced, but I cannot prove it by figures, that neuritis is a term which is now very much more frequently used than it used to be.

2550. And in the return of causes of death in death certificates, do you find that there is frequently a change in the nomenclature used by practitioners for the same disease?—I do indeed.

(Chairman.) We shall look forward with great interest to what you have promised us.

Dr. F. W. TUNNICLIFFE, called; and Examined.

Dr. F. W.
Tunncliffe.

2551. (Chairman.) Dr. Tunncliffe, you are Professor of Materia Medica and Pharmacology in King's College, London, I believe?—I am.

2552. And a member of the Departmental Committee on Preservatives and Colouring Matter in Food, etc.?—I am.

2553. You have kindly come to give us information on various subjects, and your evidence will include the researches of yourself and Dr. Rosenheim on selenium compounds as conceivable factors in the recent beer poisoning epidemic, and some other statistics?—Yes, my lord.

2554. Will you kindly give us your statement?—We came to the conclusion that there probably were other factors at work in the Manchester epidemic than arsenic, and for various reasons. And we directed our attention first of all to the sulphuric acid. We were fortunate in being able to obtain a sample of sul-

phuric acid which was sent out by the firm who sent out the arseniated sulphuric acid, and we proceeded to see if selenium were present in this acid, and we found it to be present, and in very appreciable quantities. Having done that, we further examined several other commercial sulphuric acids, and we found in them also that selenium was present, but in much smaller quantities. Then we also found, upon looking up the literature of the subject, that it was a well-known fact that selenium was present in sulphuric acid, and, indeed, already at least one other observer had found selenium in sulphuric acid in very much larger quantity, at any rate in a larger quantity than we had found it ourselves. We regard these results as of some importance, inasmuch as it appears that from time to time in commerce sulphuric acids do crop up which contain, at any rate, if they are used in the preparation of food stuffs, selenium compounds in dangerous proportion, so far as the public health,

Examination
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the health of the consumers, is concerned. This seems to be the case, not only with sulphuric acids got from pyrites, but also in sulphuric acids obtained from brimstone; and quite recently my attention has been drawn to the presence of selenium in sulphurs got from Japan. These sulphurs, I believe, contain selenium and tellurium as impurities, and not arsenic. Further, the importance of selenium in this regard has indeed been recognised in so far as in the American Pharmacopœia there are instructions and regulations for testing the medicinal preparations of sulphur or selenium. I think this is of the more importance in that it seems to me—although I have a very imperfect knowledge of technical chemistry—I think that it should be a matter of no difficulty to remove selenium from sulphuric acid. That practically completes the results that we obtained so far as concerns the acids which I have to place before you. Then we went on to investigate the question of the presence of selenium in sugars.

2555. (Chairman.) I think we will now get some more information about the acids before we pass on to the sugars. You obtained, I believe, a specimen of Nicholson's sulphuric acid?—Yes.

2556. One specimen?—Yes.

2557. And that acid contained about how much selenious acid?—3 per cent.

2558. That is 3 per cent. of its weight was selenious acid?—No, it was reckoned by volume. 100cc. of the acid contained 3 grammes of selenious acid; it was estimated as selenium.

2559. That is to say, three thousandths of its weight was selenious acid?—Yes.

2560. You reckoned the weight of a litre of sulphuric acid as how much?—We reckoned it as so much contained in so much volume.

2561. That is so much weight?—Weight contained in the volume of sulphuric acid.

2562. We understand that to mean 3 of a gramme of selenious acid per litre of sulphuric acid?—Per cent., per 100 cc. of sulphuric acid.

2563. But we have no knowledge of the volume of selenious acid?—Three grammes per litre; 3 of a gramme per 100 cc. of acid.

2564. That same acid contained about the same percentage of arsenious acid?—Yes.

2565. (Professor Thorpe.) I think it is desirable that we should be precise in this matter. What do you mean by selenious acid?— SeO_2 ; it is quite hypothetical, but we reckoned it as SeO_2 .

2566. Then had you not better call it selenium dioxide?—Yes, quite so; we mean really SeO_2 .

2567. What do you mean by arsenious acid?— As_2O_3 .

2568. (Chairman.) Do I understand you that SeO_2 is the selenious acid of your statement?—Yes.

2569. What is arsenious acid of your statement?— As_2O_3 .

2570. (Professor Thorpe.) I suppose you mean As_2O_3 ?—Yes, if you like; I am quite willing to grant that to you.

2571. As_2O_3 is the true formula, I believe—

2572. (Chairman.) That makes no difference in the statement, I suppose?—No.

2573. You examined, I believe, several other commercial sulphuric acids?—Yes; I think about five other commercial sulphuric acids.

2574. One of these acids was implicated in the epidemic, or was said to be implicated in it?—One of the other acids was.

2575. What did you find in respect to these five?—We found quantities of selenious acid varying from .01 per cent. to .004 per cent. But I would like to control those numbers further before I speak definitely about them. I may say that they were relatively very much smaller quantities.

2576. One of them, and one only, was practically free from arsenic?—Yes, that was so.

2577. What would you call "practically free from arsenic"?—We got no precipitate after we treated it for a number of days with sulphuretted hydrogen.

2578. No precipitate was formed after passing it through sulphuretted hydrogen for several days?—Yes, that is so; and it has been found by other observers, too, namely, that some of these acids which do contain selenium are practically free from arsenic.

4576.

2579. (Sir William Church.) All the others contain arsenic as well as selenium?—Yes.

2580. (Chairman.) Each one of those five contained some traces of selenium?—Yes; a demonstrable trace.

2581. And one of them contained some selenium, but no arsenic?—Yes, that is so.

2582. The greatest amount of selenium that has been found by any observer in a commercial sulphuric acid was how much?—Two acids were examined by Drinkwater, and he found 0.4 per cent.; that is about the mean of the two acids.

(Dr. Whitelegge.) Do you refer to selenium or to the dioxide?—I am afraid I cannot tell you that, but it does not make much difference. I have not the reference here, but I have it at home.

2583. (Chairman.) By weight the selenium dioxide is chiefly selenium?—Yes.

2584. And a small weight of oxygen?—Yes.

(Professor Thorpe.) It is, I think, 79 of selenium to 32 of oxygen.

2585. (Chairman.) That is, less than half and more than one-third of oxygen?—I cannot tell you whether Drinkwater reckoned his quantity as selenium or selenium dioxide.

2586. (Chairman.) Who was the observer who found as much as 0.4 per cent.?—Drinkwater.

2587. Have other observers obtained similar results as to the presence of selenium in practically arsenic-free acids?—Yes, they have.

2588. Can you name other observers?—The ones I have named here are Schlachtenhauffen and Pagel; but I believe there are many other observers, too. I believe it is the fact both as regards French and Russian acids.

2589. You speak of a dangerous quantity of selenious acid—dangerous in consequence of the use of commercial sulphuric acid containing it?—Dangerous if the sulphuric acid were used for the purpose of the preparation of foodstuffs.

2590. You mean such as glucose?—Such as sugars, which I have specially in my mind.

2591. Or effervescing drinks?—I could not speak upon that subject. I do not know what would happen to the selenium under such circumstances, but I think it would be dangerous, though I cannot say anything about that now.

2592. Would it give nip to whisky or gin?—It might give colour to it.

2593. Sulphuric acid is said to be occasionally introduced, is it not, into spirits to make it more commendable to the heavy drinker?—I believe the selenious oxide would go over into the distillate, but I have not thought about that subject.

2594. Is there any difficulty, chemically speaking, in freeing sulphuric acid from selenium?—I do not think there should be any difficulty in doing so, because in the manufacture of sulphuric acid there is present at least one of those reagents which precipitate selenious acid, namely, sulphurous acid.

2595. Would sulphurous acid, when passed through sulphuric acid, precipitate selenium?—Yes.

2596. If it was made to bubble through sulphuric acid the sulphuric acid would precipitate selenium?—Yes.

2597. (Sir William Church.) What reasons have you for thinking that arsenic did not explain the Manchester epidemic?—Well, I have put those reasons at the end of my synopsis.

(Sir William Church.) Very well; I will ask you when you come to that point.

2598. (Chairman.) What caused you to look for selenium in sulphuric acid?—Simply the fact that we thought there was some other poison present than arsenic in the Manchester epidemic. We were not satisfied that arsenic, although it expresses, no doubt, the mass of the truth, expressed the whole of the truth.

2599. (Chairman.) You will give the reasons for that later, I suppose?—Yes, subsequently.

2600. (Professor Thorpe.) As Dr. Tunncliffe is practically answerable for throwing this increased light upon the cause of the trouble he will not mind being made to tell all he can as to the possibility of selenium being a cause of the epidemic. I mean that this is the first information we have had, other than as a matter of general information, that selenium may have been at the bottom of much of the mischief?—I would not say that. I would

Dr. F. W. Tunncliffe.

1 Mar. 1901.

Selenium as a factor in causing the epidemic.

Dr. F. W. Tummidge. not say it is at the bottom of much of the mischief. I simply regard it as being a factor.

15 Mar. 1901. 2601. I think the position had better be clearly defined. May we gather from you that you think the main cause of the trouble has been arsenic, but that selenium has played a part?—Certainly; that is precisely what I think.

but subsidiary to arsenic. 2602. Although perhaps a subsidiary part?—That is not only what I think, but what I said in Dr. Rosenheim's and my own communication to the "Lancet." We used precisely that term, "subsidiary," with regard to selenium. That was in the original communication published two months ago.

Reasons for looking for selenium. 2603. What led you in the first instance to think of selenium as playing a subsidiary or as possibly playing a subsidiary part?—That again comes in at the end of the *résumé*, but I am perfectly willing to discuss the matter with you now.

2604. You are aware that what has been concerned in the manufacture of the glucose was brown oil of vitriol?—Yes.

2605. Was it the term "brown oil of vitriol" which awakened your suspicion?—No; what awakened our suspicion was simply this: We had to go over the whole of the literature, so far as it was then published, at the beginning of February, and the two cases which awakened our suspicion more than anything else were two cases reported in Dr. Kelynack's book, in which he said an infant suckled at the breast exhibited symptoms of arsenical poisoning. He says distinctly that Mr. Kirkby, about whose chemical methods we could have no possible doubt, could not find arsenic in the milk. That was a clean fact. We have no doubt whatever that Mr. Kirkby could have found arsenic if it had been present.

2606. (*Sir William Church.*) It was a mere matter of opinion. Was arsenic found in any of the secretions of the baby?—No. I am only telling you what aroused my suspicion individually in the first instance. And then we began to think of some other possible poison, and we simply read of the impurities of sulphuric acid. In the impurities we found selenium mentioned. That was the method of reasoning.

2607. (*Professor Thorpe.*) You might have started on any other impurity?—Certainly, and we did start with tellurium and thallium at that time. We got selenium from the chemical side, and then we looked up the pharmacological side, and we found that selenium was highly poisonous, and that was enough to go upon.

2608. It was not, then, the colour of the oil of vitriol that attracted you to it?—No. I quite appreciate what you say since we investigated this matter, and there is no doubt that if there were other cases of arsenic poisoning the colour would influence me. I observed and grasped the significance of the fact that when the selenium was removed from the acid the latter became practically colorless.

2609. I only wanted to get at what was in your mind, as to what led you on to the track of selenium?—Our knowledge of the relation between the presence of selenium and the colour of the acid is subsequent to the whole investigation. Now I appreciate what you say.

2610. We may gather from you, I suppose, that it was some clinical abnormality, or something of that kind, which in the first instance led you to suppose there was some other cause at work than arsenic?—Yes, certainly.

2611. Of course, the fact that selenium is not infrequently present in pyrites, and not infrequently accompanies native sulphur products, is well known?—Yes, quite.

2612. It is a chemical truism?—Oh, yes, that is so.

2613. It is also the fact, is it not, that when selenium is found in oil of vitriol the fact is so noteworthy that it seems to be at once the occasion of some remark in a chemical organ?—Well, now you put that to me I see the force of what you say, but I had not thought of that before. I see what you mean clearly.

2614. My point is, that although chemists are prepared to believe, on account of the constant association of selenium with the products from which sulphuric acid is derived, nevertheless when the sulphuric acid does contain it it is such an extraordinary and abnormal fact that they draw attention to it?—I quite agree with you, it is so. That is why I say in my conclusions that these acids "crop up" from time to time. I use that expression.

2615. Is that wholly original with you? Have you seen that same phrase elsewhere?—No.

2516. You are not aware that the same phrase is used in a paper by Mr. Davies in the Journal of the Society of Chemical Industry, where he draws attention to one of these sporadic occurrences of selenium?—No; I am not aware of it. I am very sorry, but this must be only regarded as a preliminary communication. I was not aware of that paper. I am very sorry if I have unconsciously used what Mr. Davies said, but I was not aware he had said it.

2617. The point I want to get from you is that it is a very infrequent constituent of ordinary oil of vitriol rather than a constant and frequent constituent. Is that so? Is it an infrequent or a constant constituent of commercial oil of vitriol?—I should certainly say it is relatively infrequent. I am speaking of considerable proportions; I do not mean traces.

2518. You have given the quantity associated with Dr. Drinkwater's determination. Do you know exactly how Dr. Drinkwater was led to publish his remark in the analysis about the occurrence of selenium?—No, I do not.

2619. Was it not simply in regard to oil of vitriol which was used in an oil works in the purification of paraffin?—Yes, I remember now, and that the colour of the oil went wrong.

2620. The colour of the oil of vitriol was wrong?—Yes. It was, I believe, in some shale works near Edinburgh.

2621. You told us the amount as given by Dr. Drinkwater. Are you aware of a comment which was made by Dr. Lunge on that amount?—No.

2622. Do you know Dr. Lunge's work on "Sulphuric Acid and Alkali"?—Yes, I do know Dr. Lunge as being a worker on sulphuric acid and alkali.

2623. He is, I suppose, one of the first authorities on the manufacture of oil of vitriol?—I do not know of that. I would not be prepared to say that.

2624. He says on p. 145 of his book that "the amount stated by Drinkwater seems almost incredibly high." Are you aware of that statement?—No. I will carefully read the whole of Dr. Lunge's remarks on this subject.

2625. How did you obtain the Nicholson's acid?—Well, I am perfectly willing to tell you exactly how we obtained it, but I should not like it published. I will write down the name, but I cannot have it published very well. That is the difficulty. It was obtained from a friend who is connected with some works, who has been in the habit of getting sulphuric acid from native sulphur for a considerable time.

2626. (*Professor Thorpe.*) But this is very important. It concerns the authenticity of this acid. We cannot yet really connect these results with Nicholson's acids. What we have been concerned with is the influence of Nicholson's acid on the beer?—We go on to the determination of it in beer. There is no doubt selenium was present in the two samples of beer.

2627. But we must connect it with this particular substance—

(*Chairman.*) Write the name down, please, and hand it to Professor Thorpe. (*The witness wrote and handed in the name and particulars asked for.*)

(*Witness.*) The name I have handed in is that of the gentleman who sent us the acid, and we can get to know from him the date on which it was sent from Nicholson's. That it did come from Nicholson's there is no manner of doubt.

2628. (*Chairman.*) It is very important that the date when it came from Nicholson's should be added.—I am very certain it did come from Nicholson's, and I can get the date.

(*Professor Thorpe.*) My lord, I am in your hands in this respect. There is a statement put in. It is an allegation, and that is as far as we can get. It is alleged that this is Nicholson's acid. Now the proof of authenticity of the acid is not very obvious.

2629. (*Chairman.*) Can you obtain a certificate from the person from whom you got it as to its source and the date of his getting it?—Yes, I will.

2630. (*Professor Thorpe.*) This, I believe, is the only sample of Nicholson's acid that you have dealt with?—No, it is not. There is another sample, which contained very much smaller quantity of selenium indeed, and we obtained that also under circumstances which I am obliged to call to some extent confidential. But I can tell you how we got that one, if you like, privately.

2631. You quite understand what I want is to connect this acid with Messrs. Nicholson?—Yes. I think

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Frequent
sulphuric
acid.

Origin
samples
Nicholson's
acid
examined

W. there is no doubt whatever that that acid came from Nicholson's—in fact, I am certain, and that it came just before the epidemic. I think I can prove that definitely by means of the certificate which his lordship suggests. With regard to the other acid, it was a different acid entirely, the colour was different and it was different in every way. It came from Nicholson's after the epidemic. Perhaps I had better write this down also, because it is very important. (*Information written by witness and supplied to Commission.*)

2632. (*Chairman.*) You say in your *précis*: "We further examined several other commercial sulphuric acids, one of which was said to be implicated in the recent epidemic. This, however, we doubt."—That is what we do doubt, and expresses what we think about it.

2633. In respect to the acid which contained 0.3 per cent. of selenious acid and a relatively small quantity of arsenious acid—0.3 per cent., have you any doubt that it was supplied by Nicholson's?—None at the time, and before the epidemic. That I shall be able to substantiate by a certificate.

2634. (*Professor Thorpe.*) Was the second acid examined for arsenic by you?—No, I do not think so.

2635. Was it not even tested?—I think it was tested. (*After reference to Dr. Rosenheim.*) It contained arsenic and the arsenic was estimated quantitatively.

2636. Can you tell me the amount?—1.4 per cent. of arsenic.

2637. In this second acid?—Yes.

2638. You say there was 1.4 per cent. of arsenic in the second acid?—Yes.

2639. (*Professor Thorpe.*) And what was the amount of selenium there?—I have got the four remaining acids, apart from Nicholson's, massed together as containing from 0.01 to 0.004 per cent. of selenium. I cannot tell you which it was.

2640. (*Chairman.*) And one of those acids you say contained 1.4 of arsenic?—Yes.

2641. Did the remainder of those four contain much arsenic?—No, not much. I cannot tell you what they contained. I have not got the figures here for the arsenic.

2642. When you speak of 0.3 per cent. of arsenious acid in the sulphuric acid as being a relatively small amount, do you mean that it is the same percentage as that of the selenium—0.3?—That is so.

2643. But being arsenic it is relatively small?—It is.

2644. Could you tell us by what methods the selenious acid was estimated in the sulphuric acid which you tested?—It was precipitated by means of sulphurous acid.

2645. What was done with the precipitated material?—It was filtered and weighed.

2646. (*Professor Thorpe.*) What is your reason for stating that the acid which you got from the place you have now indicated, the first place—this acid which did not come in the direction of Bostock's at all—was the same as that which was used in the manufacture of Bostock sugar?—Simply because it was obtained from Nicholson's at the same time. It was obviously one sample of their issue of acid.

2647. Do you know what it was characterised as when it came to you?—Yes. It was characterised as D.O.V.—distilled oil of vitriol. It was probably a purer product than the B.O.V. It was labelled D.O.V.

2648. This is important. The acid you got in the way you have described to us was D.O.V.?—Yes.

2649. That is the first of the two referred to?—Yes. It was labelled D.O.V., and that was the one which contained the 0.3 per cent. of selenious acid.

2650. What did you think D.O.V. meant?—I thought it meant distilled oil of vitriol.

2651. You are not aware, then, that it means double oil of vitriol?—No.

2652. You assumed it had been distilled?—Yes, I thought so.

2653. (*Chairman.*) Was it clear in colour?—No, it was dark in colour—about the colour of this book—a distinctly dark brown.

2654. Nearly the same colour as the B.O.V.?—Very nearly.

2655. (*Professor Thorpe.*) Why should it be such a dark colour if it were distilled?—I do not know. I do not know anything about it. I did not know what the D.O.V. meant. I know that it was on the label, that is all.

2456. Did you know that Bostock's used D.O.V.?—No. I knew that Bostock's used B.O.V.

2657. What is the distinction in your mind between B.O.V. and D.O.V. as applied to oil of vitriol?—I thought D.O.V. was rather a purer oil of vitriol than B.O.V. That was my idea.

2658. Perhaps it is rather unfair to ask you this, because you are not an expert in the manufacture of oil of vitriol?—No, I am not. I can only tell you what was on the label and what I thought. I do not know really what D.O.V. means. It is Greek to me. It does not interest me.

2659. But it is a fact that Nicholson's supplied Bostock's mainly with brown oil of vitriol—that is, B.O.V.?—That I know.

2660. That is a comparatively dilute acid?—Yes?

2661. D.O.V.—double oil of vitriol—is a very much stronger acid and approximates much more to real sulphuric acid?—Yes?

2662. You took 100cc. of this double oil of vitriol for the purpose of your estimation?—Yes.

2663. (*Chairman.*) What would be the weight of that 100cc.?—I do not know. We did not weigh it.

2664. (*Professor Thorpe.*) Did you make the determination yourself?—Yes.

2665. When you poured it out of the bottle had it the viscosity and thickness of oil of vitriol?—Yes, but I did not notice the point at the time, and I cannot tell you I have seen the acid and had it in my hand, and so forth, and manipulated it.

2666. If it were what we commonly associate with the ordinary oil of vitriol it would have a specific gravity of 1.8—very nearly twice as heavy as water?—Yes.

2667. Your 100cc. would be at least 180 grammes of material?—Yes.

2668. Your three-tenths, then, is calculated on 180?—Yes.

2669. That very nearly divides it by half, does not it?—Yes.

2670. We have it from you that the acid you examined was D.O.V., whereas what Bostock's used was B.O.V., which is an acid obtained at an earlier stage in the manufacture of sulphuric acid?—Yes.

2671. D.O.V. is a product which is obtained at a subsequent stage of the manufacture?—Yes.

2672. So that you were not getting the same thing as Bostock's were using?—I did not say I was.

2673. In your *précis* I think you said, "We were able to obtain for analysis a sulphuric acid manufactured by Nicholson's, and which we have every reason for believing was used in the manufacture of Bostock's brewing sugar." What other acids did you examine other than the second of Nicholson's?—There were acids which were bought in the open market. Do you want me to tell you the names of the makers?

2674. If you can?—One was Hartmann.

2675. (*Chairman.*) Is that German sulphuric acid?—I do not know where it comes from. I am afraid I cannot tell you the names of the other makers.

2676. (*Professor Thorpe.*) Were they bought from shops or from wholesale dealers?—They were bought from wholesale dealers. They were obtained by friends of mine in the North.

2677. Were they all pyrites acid?—I think so.

2678. In these small determinations—the small amounts Method of that you obtained—did you in all the cases weigh the testing for selenium as such—that is to say, after reduction with sulphurous acid, or did you use any other method?—We weighed it as such.

2679. You weighed it as selenium?—We calculated it as selenious acid.

2680. I understood that you precipitated it by means of sulphur dioxide?—Yes, we weighed it as selenium.

2681. In every case where you estimated the amount you say you weighed it as selenious dioxide?—We weighed it as selenium.

2682. Are all your estimations selenium?—Yes, actual gravimetric estimations of selenium.

2683. (*Chairman.*) 0.3 per cent. is selenious acid?—Yes, reckoned from the amount of selenium.

2684. What have you to say about selenium in sugar? Selenium in—Then we turned our attention to the sugars, and we Bostock sugar.

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got a sample of invert sugar from Bostock's, and we estimated the selenium in that sugar. We found that it contained 0.1 gramme of selenium per thousand, or 0.14 of selenious acid, or one part in 7,000.

2585. Is that per thousand by weight?—Both the selenium and the sugar by weight. Then we made some experiments with regard to the behaviour of selenious acid in solutions of glucose. We found that you could get a solution of selenious acid in glucose of very considerable strength without any difficulty. Then we thought it was a matter of some interest to determine how yeast behaved in a seleniated glucose solution, and therefore we made some experiments with that object in view. We found that the yeast reduces some of the selenious acid in the solution of glucose to selenium, and becomes coloured in the process. We found further that the activity of the yeast, except in very strong solutions, was unaffected by the presence of selenious acid. These observations, so far as the yeast is concerned, are entirely in accord with those of other observers with regard to the action of selenious acid upon bacteria and upon moulds. I think that is all we did so far as sugars are concerned.

2586. (Professor Thorpe.) You told us that you examined two sugars which came from Bostock's?—No; one sugar came from Bostock's and the other did not come from them.

2587. Then only one sugar came from Bostock's?—One was Bostock's invert, and the other a glucose of German origin.

2588. In Bostock's invert did you determine the selenium quantitatively?—Yes.

2589. Did you in the German glucose?—No.

2590. Was there any appreciable quantity in the German glucose, do you know?—You could demonstrate its presence, but it was not present in any considerable quantity.

2591. What test did you apply in the case of the sugars, the qualitative estimation in the first instance?—We got the selenium from the sugar solution by means of a deposition upon zinc in the presence of acetic acid. Then we dissolved the selenium off the zinc by means of cyanide of potassium, and then we precipitated it and purified it by certain methods, and weighed it. So far as the qualitative detections were concerned we got it in various ways, sometimes on copper, and then removed the selenium from the copper by cyanide of potassium, and then proceeded micro-chemically with regard to it.

2592. I understand you that this determination of 0.01 per cent. which you found in Bostock's invert was made by reducing the selenium by zinc in the presence of acetic acid—how do you suppose the selenium is present there?—I do not know how it is present there. I do not know in what form selenium is present in sugar in the least; I should presume it was selenious acid, but I could not say.

2593. Do you remember if your sugar dissolved perfectly?—Yes.

2594. You would suppose that the selenium was oxidised then?—I did not suppose it was present as selenium itself. I did not understand you to mean that. I thought you meant to ask me how I thought it was present, and I did not know. I know it was present in the soluble form, and not as selenium.

2595. And you reduced it by the action of the zinc in presence of acetic acid?—Yes.

2596. It was deposited on the zinc?—Yes, you could see that. The red precipitate on the zinc is quite clear.

2597. And you dissolved it off with cyanide of potassium?—Yes.

2598. And then you re-precipitated it?—Yes, and then we got rid of the hydrocyanic acid, and took it up with alkali and oxidised it again with peroxide of hydrogen, because we found when we simply precipitated it from the cyanide of potassium we got the selenium down in a flocculent form, probably contaminated with organic matter. When it was obtained from the cyanide of potassium, or when it was re-oxidised, so to speak, and then subsequently precipitated with hydrazine sulphate, we got it down in absolutely a hard metallic form, so metallic that you could hear it scrape against the side of the glass.

2599. But still as a red precipitate?—It was quite a different form to the other form, and that is really what made it rather difficult because we weighed the selenium

in one estimation in beer and then found that it was no doubt slightly contaminated with organic matter, and we have discarded that result. The two states of deposition are very different indeed.

2700. What was the relevancy of the fact that you found selenious acid to dissolve to almost any extent in sugar?—I quite admit the idea may have been amateurish; but we wanted to see first of all whether the sugar acted upon it as such at all.

2701. Selenious acid is so soluble that it would dissolve even in water?—Yes. I do not defend the method; but we wanted to see anyhow, and we did it. Those experiments with yeast are certainly of interest. It seems that yeast does take up the selenium, and that it is a biological combination, because if you kill the yeast first it does not take up the selenium.

2702. Have you made inquiries in breweries which you supposed to be using Bostock's sugar?—No; we have made no inquiries of any breweries of any kind whatever.

2703. The object of my question was to ask whether the occurrence of these pink yeasts had been noticed?—We have made no inquiries of any kind. That will be an extremely interesting point to elucidate.

2704. (Chairman.) What have you to say about beer?—We were able to obtain two samples of beer from Salford, and in this beer we were able to demonstrate qualitatively the presence of selenium, and also to estimate it. In Sample A we made two estimations, but in Sample B we have only made one estimation. The result was that we found sample A of the beer contained 6.2 milligrammes per litre, or rather more than the third of a grain per gallon reckoned as SeO_2 . Sample B contained 5.8 milligrammes in the litre, reckoned as SeO_2 , which equalled .36, which is rather more than the third of a gallon of selenious oxide per gallon. This beer also contained arsenic; we did not enter into that subject ourselves, but we are informed from an independent analysis that it contained about a grain of arsenic to the gallon, each sample. I submit that these results, so far as beer is concerned, show that when selenium is present in the sulphuric acid which is used in the manufacture of invert sugar, it does come out into the beer, and in case the sulphuric acid in question should contain quantities such as those which were contained in the acid we examined, viz., 3 per cent.—I may say that the beer and the sugar had no direct relation to the original acid, so far as we are aware—it might be a very considerable source of danger to the public health.

2705. (Dr. Whitelegge.) It would be lessened to some extent by the action of the yeast?—To a very slight extent, indeed. We did make some estimations to see how much was taken up by the yeast, but the quantity was very small, relatively as well as absolutely.

2706. (Sir William Church.) Would it in all circumstances colour the yeast?—Yes, up to about 1 in 40,000 roughly; but we are continuing with that at the present time.

2707. (Chairman.) Would the selenious acid, SeO_2 , colour the yeast?—Speaking generally, it would.

2708. (Professor Thorpe.) Are you inclined to tell us the names of the breweries?—I think I can tell you all about the sugars and about the brewers. One sample of invert sugar was obtained by Mr. Gordon Salomon. I had an opportunity of communicating with him, and he was exceedingly interested in the subject, and very kindly at once placed at our disposal this sugar. There is no question about this sugar; it has nothing to do with the original acid.

2709. Is the sugar that you got connected with the beer which you subsequently analysed?—Only in so far as it is Bostock's sugar.

2710. It was not obtained from a Manchester or Salford brewery which brewed the beer that has been giving trouble?—I cannot tell you that. The bottle came to us from Mr. Gordon Salomon, and on the label was "Bostock's invert." That is all I know about the origin of that sample.

2711. (Chairman.) Do you mean a bottle of beer?—No, a bottle of invert sugar.

2712. That you obtained in connection with the beer from the Salford brewery?—No. The invert sugar was not obtained from a Salford brewery. It was obtained from Mr. Gordon Salomon, and was labelled "Bostock's invert."

2713. Did you get it with reference to any connection with the beer you had from the Salford brewery?

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Selenium in
beer.

and in
German
glucose.

Origin of
above
samples.

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—In connection with it in our own minds, but not otherwise. We got it because we wished to have it in that connection.

2714. (*Professor Thorpe*.) What was the name of the Salford brewery?—I may say I am very imperfectly acquainted with the whole of the sociology of this epidemic, but I know that "Groves" is on the bottle, Groves and something else.

2715. Was it Groves and Whitnall?—Yes.

2716. Were both samples from Groves and Whitnall?—They were in Groves and Whitnall's bottles. They were in bottles marked in that way.

2717. Are you able to inform us the date of the brewing of that beer?—Yes, I am certain that it was beer implicated in the epidemic, or I dealt with it as beer implicated in the epidemic.

2718. (*Sir William Church*.) I do not think you need be reticent with regard to Groves and Whitnall, because they have been before us?—The beer was in their bottles, and was part of the original batch got for the epidemic investigation.

2719. When?—In November.

2720. Directly the suspicion of the epidemic arising from arsenic occurred?—Yes.

2721. (*Professor Thorpe*.) Was the beer draught beer put into bottles?—No; I should think it was bottled beer, because it was effervescent.

2722. Might it have been some time in bottle?—Yes.

2723. Might it have been made prior to the mischief we are talking about having become known to the public?—I should think it was bottled beer. I think that is so, Dr. Rosenheim?

(*Dr. Rosenheim*.) It was bottle beer containing arsenic and selenium—that is all we can say.

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2724. (*Dr. Whitelegge*.) Just at the end of that section of your *précis* you say that in the case of Nicholson's acid and Bostock's invert it was present in the beer in poisonous quantities?—Yes.

2725. Does that mean that in the quantity found in the samples of the beer, the selenium would be poisonous?—Yes, it does mean that. It means that it would be poisonous as selenium quite apart from the arsenic.

2726. But you say "In the case of Nicholson's acid and of Bostock's invert"?—I mean that supposing a glucose or invert were manufactured from the acid containing as much selenium as the Nicholson's acid we got contained, it would be then present in the corresponding beer in poisonous quantities.

2727. There are two propositions, and you mean to cover them both?—Yes; the acid we got did not correspond either to the sugar or to the beer, nor did the sugar correspond to the beer.

a beer.

2728. (*Chairman*.) Then you refer in your *précis* to further information as to selenious acid being present in the beer in poisonous quantities?—Yes. I refer to what I have to say upon the poisonous properties of this substance and its compounds.

2729. What have you to say with reference to the malt?—With regard to the malt we have done nothing whatever. But I would point out that the flue dust of certain coal and coke contains selenium and possibly by the process of kilning malt we might introduce selenium into it. That is a mere suggestion. We have had no malt and we have done nothing in that way.

2730. (*Sir William Church*.) Have you had any flue dust?—No; this is simply second-hand information from a publication.

2731. (*Professor Thorpe*.) That has no greater value, has it, than that selenium is frequently present in all flue dust obtained where pyrites of any kind has been observed—that is all it means, is it not?—Yes.

2732. (*Chairman*.) Are we to take it that selenium is generally present in pyrites when arsenic is present?—Yes, that is so, and it is present apparently in sulphur without arsenic.

2733. Is it present in Sicilian brimstone?—Yes.

2734. Is there any arsenic present in Sicilian brimstone?—I do not know about arsenic in Sicilian brimstone, but when I speak of the selenium being present in sulphur without arsenic I am speaking especially of some Japanese sulphurs which were referred to by the editor of the "Journal of Chemical Industry" at the Society of Chemical Industry; some Japanese sulphurs

which have been examined contain selenium and tellurium and not arsenic.

2735. Is that Japanese sulphur a natural product?—I think so.

2736. (*Professor Thorpe*.) Mr. Gordon Salamon told us that Japanese sulphurs were characterised by containing notable quantities of arsenic?—This information I only give you for what it is worth. I am not responsible in any sense for it.

2737. (*Chairman*.) What about the pharmacology of selenium?—This is simply a resumé of the experiments which have been made upon selenium compounds, and it seems pretty clear from them that so far as acute poisoning is concerned, selenious acid is almost identical both qualitatively and quantitatively with arsenious acid. But, so far as chronic poisoning is concerned, it seems there are certain differences, and these differences have, I think, some application with regard to the present epidemic. For instance, one of the differences is the fact that in a number of animals poisoned by arsenic and poisoned by selenium it was found that the animals became tolerant to the action of arsenic, or in other words that more arsenic had to be given to them in order to obtain the symptoms of arsenical poisoning as time went on; whereas, on the other hand, in so far as it concerns the selenium compounds, it was found that less selenious acid had to be given to produce the symptoms, and if the same quantity of selenious acid was continued the animal died. This seems clearly to show as far as the experiments go that the poisoning action of selenious acid is more cumulative than the poisoning action of arsenious acid. A further point of interest in this connection is the fact that selenious acid causes very marked wasting, and this wasting seems quite independent of any deficiency in the assimilation of food. In the case of arsenious acid poisoning the wasting is probably to some extent at least dependent upon the fact that the patients get inflammation of their stomach and intestines, and thus are not in a position to assimilate the food—the food does not actually get into the body, whereas in the case of the selenious acid, there is no doubt from exact experiments and its action upon metabolism that it causes an increased breaking down of the tissues and that the wasting is to be explained from that. I think that is all I have to say as far as concerns the action of these substances.

2738. (*Sir William Church*.) With regard to that statement you have given us of the comparison of the action of arsenic and selenium upon animals, were the same sort of animals used in each case?—Yes.

2739. The same species?—Yes. The experiments have been made on several species of animals, but when it was a question of comparison animals of the same species were compared in Medica's experiments. But these results do not rest on simple experiments on one species of animals; they cover cats, dogs, rabbits, and of course, frogs.

2740. The frog is hardly comparable physiologically with the other animals?—It does not rest upon the one species at all, but upon carnivorous and herbivorous animals, and animals of a mixed diet.

2741. Has there been a case of selenium poisoning in man?—Selenium has never been looked for as a source of poison in man. I think it will be now, and we may have some cases of selenium poisoning recorded in the future. Japtha took selenium himself, and he noticed that he lost flesh, and noticed little else, but selenium as such is only slightly poisonous.

2742. It is the dioxide that is poisonous?—Yes; and probably other compounds too, compounds analogous to the arsenic compounds.

2743. With regard to the experiments of Japtha, Weil, and others, it is quite certain that they were working with pure materials? May they not have been working with arsenic as well as selenium?—That is a matter I am not prepared absolutely to answer now. I should think that at any rate, as the experiments of Medica were made directly for the purpose of comparing arsenic with selenium—

2744. But these others?—I should think they were also; as they were done in a good pharmacological laboratory at Prague I should think they would be careful to re-crystallise and purify their drugs. It is a thing we should ordinarily adopt, as it is a recognised thing to do in pharmacological work, to see that your elements are pure.

2745. Have you made any experiments yourself?—

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Evidence of
poisonous
action of
selenium on
lower
animals;

on man.

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15 Mar. 1901. Absolutely none. In the first place I have not been able to make them because of the time, and in the second place, in this country experimental work is not easy on account of the Prevention to Cruelty to Animals Act. It takes about six weeks to get a licence.

2746. (Chairman.) Could you give us any reference to the authorities you quoted?—Yes; I have two of the books here.

Toxic effects of selenium like those of arsenic.
2747. (Sir William Church.) The physiological effects as given here of selenious acid are very closely allied to those of arsenic?—Yes, they are; the acute poisoning is practically identical. These references have been already given in my *précis*.

2748. Do you know whether selenious acid, when taken, produces gastric symptoms? That appears to be a difference between the action of the two physiologically?—It does not produce gastric symptoms to the extent that arsenic does. I think that is known.

2749. (Dr. Whitelegge.) Is there any proof that it produces pigmentation?—The experiments have always been made on animals with hairy skins and dark coats, and of course pigmentation in the case of an animal would be very difficult to see. There is no doubt whatever that selenious oxide is reduced to metallic selenium in the tissues—that is known. Of course, the probability is that pigmentation would occur, but it is practically impossible, without you take very special precautions, to discover pigmentation in an animal.

2750. (Chairman.) You said that Japtha took selenium—that is not selenious acid?—No.

2751. Would selenium pass into his tissues without any part of it being converted into selenious acid by the juices of the stomach, or otherwise?—I should think it would not be converted into selenious acid. I should think it would enter into combination in the same way that arsenic does, with the nucleo-proteids, like phosphorus and arsenic.

2752. (Sir William Church.) I understood you to say to me that you thought selenium was harmless?—Yes, so it is—relatively harmless.

2753. Yet according to Japtha it produces wasting?—I should think that selenium is relatively non-poisonous compared with selenious acid. I especially emphasised the fact that even the metal itself produced certain symptoms.

2754. Do you remember what quantities he took?—I do not know. That was published in 1842; and I have not had the means of consulting the original authority on the subject.

2755. (Professor Thorpe.) If a person takes sulphur, is there any formation of sulphuretted hydrogen? Supposing you took sulphur simply as flowers of sulphur?—There is occasionally, especially in the skin, and it is excreted sometimes in the form of sulphuretted hydrogen by the skin.

2756. Has it a marked result?—If you took enough of it you would get a marked result, but not with small quantities.

2757. Has it been discovered that selenium gives rise to selenuretted hydrogen in the same way?—No. Experiments have been made on that subject by Hoffmeister, and he found that outside the body selenium does combine like tellurium, and forms a methyl selenium compound $\text{Se}(\text{CH}_3)_2$. Tellurium is excreted by the breath as a methyl tellurium which smells oniony.

2758. Does selenium give rise to a similar effect on breath?—We do not know.

2759. You do not know whether it gives rise to selenuretted hydrogen?—No.

2760. You understand the point of my question, that these things are so intolerable in regard to the smell they give?—I quite understand what you mean.

2761. Therefore, if selenium gave rise to any secondary products of this kind its presence would be known?—Yes; it would be seen at once; that is the point I have entered into very considerably. Tellurium occurs as an impurity in bismuth, and patients who take bismuth do very often complain of an oniony taste in their mouth and their friends complain of their breath. That is due to the methyl tellurium.

2762. (Chairman.) Tellurium, selenium and arsenic have all the property of the garlic smell?—We are not able to say that definitely of selenium, but of tellurium and arsenic we can say so.

2763. Can metallic arsenic be taken with comparative impunity?—Yes; arsenium itself is relatively non-poisonous.

2764. Is it safe to eat any considerable amount, a grain or two, of the pure metal arsenium?—I believe so, providing it is pure arsenium.

2765. (Chairman.) You have some general remarks on the presence of selenium compounds in the beer, effect and the pharmacology of this subject, in connection with the symptoms in the Manchester epidemic?—I produce a few remarks to make under that head. First of all, it has been noted by many people that the doses of arsenic taken by these patients were very small; in fact, it has been questioned whether these small doses of arsenic were capable of causing the symptoms. Without expressing an opinion upon that point, I will simply say that in all probability—in fact, pretty certainly—to these small doses of arsenic must be added also a small dose of selenium, and hence these symptoms would be more easily explainable, because you would have two factors at work. Another point of interest in this connection is the almost entire absence of tolerance in the Manchester epidemic, so far as one can judge of it from the literature on the subject. We have very definite reasons for supposing that tolerance to arsenic does occur. The Styrian arsenic eaters, clinical evidence, and in addition, exact pharmacological experiments, are all evidence that animals and human beings do become tolerant to the action of arsenic. The evidence, so far as we have it, goes to show that animals do not become tolerant to the action of selenious acid, and therefore I think the presence of selenious acid in this beer also helps us to some extent to understand the apparent non-tolerance in Manchester. Again, if we look carefully into the question of the wasting occurring in the Manchester patients, we find that a good deal of wasting occurred there apparently unassociated with intestinal inflammation, whereas the wasting due to arsenic is nearly always associated with gastro-intestinal inflammation. Here again I think the presence of selenious acid helps us to explain this, because in the case of the action of selenious acid, wasting is due to the breaking down of tissues, and not to diminished assimilation of the food. Of course, there are those two cases which are specially reported by Dr. Kelynack, in which no arsenic was found, although the symptoms were identical with those of arsenical poisoning; those cases could be explained by the assumption that selenium was present in the ingesta. If we direct our attention to the many other epidemics of arsenical poisoning that have occurred, and, indeed, to the description of arsenical poisoning in text-books, we find that different kinds of arsenical poisoning are described—the paralytic form, the pigmentation form, the gastro-enteric form, and so forth. These different forms of arsenic poisoning no doubt may be due to some extent to difference in dose; but I think they may be also explained by the fact that arsenic may have been associated with selenium. The selenium has never been looked for, and therefore has never been found. But I think the aberrancy or the inconstancy of the symptoms of arsenical poisoning are due to the fact that we are not really working with pure materials, and that the poisoning is an arsenic-selenium poison, or arsenic-selenium-tellurium poisoning.

2766. Has anyone found tellurium in any of the ingredients of beer?—Not this time, as far as I am aware.

2767. But do you think it might possibly get in?—Those last remarks of mine were directed to the previous epidemic; for instance, the arsenic epidemic in bread in Bavaria a few years ago and an arsenic epidemic at Hyères. I was not referring to the Manchester epidemic, I was speaking of the arsenical poisoning in former epidemics.

2768. Was it ascertained that tellurium was present?—It was never looked for; neither tellurium nor selenium has ever been looked for.

2769. (Professor Thorpe.) The Hyères epidemic was a case where apparently arsenious oxide had been used in the plastering of wine?—Yes.

2770. And your surmise is that the arsenious oxide might be contaminated with selenium?—Yes.

2771. Have you any evidence of that?—No. It is the first time selenium has ever been brought forward. With regard to the toxicology of selenium, this must be regarded as a preliminary effort, as selenium has never been looked for. Now we are able to say abso-

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lutely that this substance is poisonous, and that it does get into food stuffs. I think in the future we shall all be on the look-out for selenium, both toxicologists and pharmacologists. Heretofore we have not been, although I do not know why.

2772. Confining ourselves to the case of the Hyères epidemic, there the ordinary commercial arsenious oxide was apparently used in substitution of plaster of Paris?—Yes.

2773. Your surmise is that even that product might contain selenium or selenious acid?—Yes; or tellurium.

2774. (Chairman.) Arsenic is made on a very large scale for many purposes. Have the manufacturers or chemical experts ever looked for tellurium or selenium in their products?—I do not think so.

2775. (Professor Thorpe.) You yourself have not looked for them in commercial arsenic?—No.

2776. The arsenic produced, for example, in Cornwall?—No.

2777. Is it, considering the mode in which that substance is prepared, in the least degree likely that the volatilised arsenious oxide will contain selenium?—I really could not say.

2778. You are not familiar with the method of making arsenious oxide?—No.

2779. (Dr. Whitledge.) What symptoms in the former epidemic do you regard as aberrant?—For instance, in the Würzburg epidemic there was only one case of paralysis recorded. That case was rather interesting, because it was in bread, and the dose approximately would be relatively constant, at any rate as compared with beer. Of course, the dose is a great fallacy in this Manchester epidemic.

2780. It is difficult to determine?—Yes; practically impossible.

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2781. I understood you to quote to us some experiments in which selenium caused paralysis?—Yes.

2782. And you identified the manifestations of selenium poisoning with those of arsenic?—Generally speaking.

2783. Would not the general absence of paralysis in those results be equally hostile to selenium as to arsenic?—No, not necessarily. They might be mixed in such a way that one would counteract the other. I am simply giving that as an instance of the fact, because I think that the so-called arsenical epidemics are probably not due entirely to arsenic. We are not working with a pure substance.

2784. Is it known that the wasting caused by arsenic is due solely to the interference with assimilation?—I do not know that it is due solely to that, but I do know that it is generally associated with a diminution of assimilation. I do not think experiments have been made with regard to the action of arsenic in the same sense that they have with regard to the action of selenium.

2785. Would you expect in the case of arsenical poison conveyed by beer that there would be less irritation of the stomach and intestines by reason of extreme dilution?—I should.

2786. So that the interference with nutrition would not be so marked?—Quite so.

2787. Does it occur to you that in the history of the Manchester cases there was more wasting than is usual in arsenical poisoning?—I am afraid I could not say.

2788. I am simply referring to your remark that "the marked occurrence of wasting in the Manchester patients occurring independently of gastro-enteritis, is to be explained by the specific action of selenious acid"?—I am afraid I could not push it to that extent.

2789. (Sir William Church.) What makes you say, "The marked occurrence of wasting in the Manchester patients occurring independently"—was there a very marked wasting?—Yes; and in addition to that, the arsenic was taken in very dilute form, and there was relatively little amount of gastro-enteric trouble.

2790. But a large number of them were not wasting at all, were they?—I am only going by the published records.

2791. What tissues were wasting, the muscular or the fatty?—Both the muscular and fatty tissues, as far as I have read.

2792. I have seen some of these patients myself, 4576.

and wasting did not appear to me to be a very leading feature?—I am only speaking from what I have read.

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2793. In the same way, you say the almost entire absence of tolerance to arsenic in the Manchester patients; what leads you to think that the people were not very tolerant of arsenic? I came to a different conclusion?—Because of the fact that the small doses of arsenic continued for a certain time produced very definite symptoms in Manchester.

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Tolerance of
arsenic.

2794. But we have only evidence of it in some two or three thousand cases?—It is very definitely stated in Dr. Kelynack's book, that people who took small doses got large symptoms.

2795. But you say "marked tolerance." The population did show, perhaps, a tolerance to arsenic. There have only been some two or three thousand cases at the most traced, and perhaps you have not seen the evidence of the amount of beer drunk in those towns?—No.

2796. (Professor Thorpe.) Did you read the evidence in the Manchester inquest?—Some of it.

2797. Do you remember the evidence of a man whose wife died, and who himself said he had consumed very much larger quantities of beer than his wife, who was supposed to be killed with arsenic?—I do not remember that.

2798. And that arsenic was actually found in her viscera?—I do not remember that.

2799. If that were so, that would show a considerable amount of tolerance on the part of the man?—It would.

2800. (Sir William Church.) The quantities of arsenical beer that we know must have been consumed were very large?—Yes.

2801. With regard to Modica's experiments showing the non-tolerance of selenium, do you know what number of experiments he made?—I think about a dozen experiments. He gave the animals the substance for about forty days.

2802. All the same animals?—Yes. He worked entirely on rabbits, poisoning some with selenious acid and some with arsenious acid. Those were the cases of chronic poisoning. Of course he made other experiments than those.

2803. That generalisation is come to from a dozen rabbits?—Yes, practically.

2804. Is it not a known fact clinically that you get very many different forms of arsenical poisoning from the administration of medicinal arsenic?—Yes.

2805. Do you think that contains selenium?—We are at present investigating that matter, the question of liquor arsenicalis and the question of the sulphur compounds of the pharmacopœia. Perhaps I put this a little too strongly, but all I wanted to emphasise was that, apart from the difference of dose, the getting of different kinds of symptoms points in the direction of the substance one is working with not being absolutely constant.

2806. Still, taking it, as I think we may, that medicinal arsenic is fairly pure, you may have a very great variety of symptoms in different individuals. You get pigmentation in some when given medicinally, you get catarrhal symptoms often in others, and in others you get gastro-intestinal trouble?—Yes.

2807. So that unless we have been in the habit of giving an impure drug, the difference in the symptoms does not go for much?—No.

2808. (Professor Thorpe.) There is other evidence, I think, for the substantial purity of commercial arsenic. Large quantities of it are used in certain volumetric estimations, and the nature of those estimations is such that if selenium had been there in any sensible amount the oxide of selenium would have been reduced, and the resultant selenium would have at once manifested itself?—Yes. These are only suggestions I make, and I do not attach any very great importance to them.

2809. I venture to say that you will find when you continue your inquiries that arsenious oxide from the very nature of its mode of preparation is practically almost a pure substance—almost as pure as can be made?—I say that this is very incomplete, and I do not attach any very great importance to these suggestions. They are suggestions rather than facts.

2810. (Chairman.) Has selenium ever been administered as a drug for curative purposes?—No, tellurium has, but not selenium.

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Arsenic in
phosphate of
soda causing
poisoning.

2811. Does tellurium appear in the Pharmacopœia?—No.

2812. Judging from all the facts that you have put before us, you consider it of great importance that selenium should be further investigated—the possibility of selenium appearing in food and drink?—I do.

2813. I see you mentioned a case of arseniate of sodium poisoning occurring in a family in 1900?—Yes.

2814. And I see one patient took as much as 17 grains of the arseniate of sodium?—Yes.

2815. The substance in which it was taken was phosphate of soda?—Yes.

2816. Was it an impurity in the drug?—Yes.

2817. There might be a little ambiguity in this statement, because this substance might refer to the latter, but it is really to the former?—It refers to the arseniate of sodium.

2818. Was that patient killed who took as much as 17 grains?—No, he did not vomit for about 12 hours, and then he vomited and had diarrhoea. About a week afterwards he had an attack of shingles, and three weeks afterwards he got jaundice.

2819. Was that probably due wholly to the arseniate of sodium?—Certainly, the shingles and the other symptoms were, and the jaundice too, I think, in all probability. It is difficult to be quite certain about jaundice, but I think most likely it was.

2820. Did he recover from the jaundice?—Yes.

2821. Was his health permanently injured by so severe an ordeal?—It was injured for some considerable time.

2822. (Sir William Church.) What reason have you for thinking that the herpes was more immediately connected with it than the jaundice?—He was a bilious subject and had had jaundice before. I do not think that the jaundice was really due to the arsenic.

2823. Were there any nerve symptoms in connection with the herpes?—No.

2824. I suppose the herpes is secondary to a nervous condition?—Yes.

2825. Did he get any paralysis?—No. The people who took the arseniate of sodium were his wife, his two children, and himself.

2826. (Chairman.) Did they all take the same drug?—They all took an alkali powder which was prescribed containing phosphate of soda, bicarbonate of soda, and sulphate of soda, and this powder was more or less used as a constant medicament by the whole family. The children were sick immediately—I do not know how much they took—and the wife was sick immediately and had diarrhoea, and was in a state of collapse for a few days. Then she got a peculiar erythematous skin eruption. The husband, whom I know more definitely about with regard to the actual time and the actual amount taken, took 17 grains of the arseniate of sodium, and he kept it in his stomach for twelve hours. He took it at night, and was not sick until after breakfast in the morning.

2827. You mean that he vomited and got rid of some of the substance?—Yes.

2828. Seventeen grains of arseniate of sodium out of a mixture of phosphate of soda and two other substances must have involved a tremendous amount of arseniate in the phosphate?—It did.

2829. Is there a liability now to such a drug as phosphate of soda being contaminated with arsenic?—This was due, not to chemical causes, but to the fact that two drugs were dried together, arseniate of sodium and phosphate of soda.

2830. By the apothecary?—No; by a manufacturing chemist—and they got mixed. The chemist at once referred to the manufacturer, and the supply of phosphate was at once withdrawn. Fortunately we found this out in a few days. At first I thought these persons were suffering from ptomaine poisoning, as they had eaten a Russian partridge for dinner on the same evening. They got running of the eyes and nose, and that again made me think of antimony, but the analysis showed that it was not tartar emetic, but arseniate of sodium. It was a very terrible accident.

2831. (Professor Thorpe.) Did you trace that up?—Yes.

2832. They were simultaneously drying the two?—Yes.

2833. I ask the question, of course, because a good deal of phosphoric acid is now made directly from phosphorus?—The retail chemist was aghast at the trouble, and referred the responsibility to the wholesale chemist, and I had several interviews with the retail chemist, and that was the statement he made to me. This was in April, the week after Easter, last year. The manufacturer at once withdrew the whole of the phosphate, and that is all that happened.

2834. I suppose it is still possible, apart from that, that phosphate of soda may contain arseniate of sodium?—From chemical reasons?

2835. Phosphorus almost invariably contains arsenic, does it not?—Yes.

2836. When it is oxidised, of course it is oxidised to arsenic acid?—Yes.

2837. If you convert the phosphorus into phosphoric acid, inasmuch as the arseniate of soda and phosphate of soda are isomorphous and crystallise together, no doubt they will afterwards occur together?—Yes. This was distinctly mechanical, I believe. I only know what they tell me. Perhaps you will remember there were several cases at the same time; there was a case of a patent alkali medicine, and there were several prosecutions last spring.

2838. (Chairman.) Depending upon the same lot?—Yes. I know that in two other cases I was consulted with regard to it.

2839. Were there any deaths?—I think not. It was the arseniate, and the arseniate is very much less poisonous than the arsenite, though the Pharmacopœial doses are the same.

2840. (Professor Thorpe.) Is that true of the free acid?—I think so.

2841. I asked that question the other day, but it does not seem to be quite clear?—There have been a number of experiments made on the relative poisonous properties of the arsenites and arseniates, and I think some on the acids, and there is no doubt that the arseniates are not anything like so poisonous in the same proportion.

2842. (Chairman.) Will you send in the full account for our information as to the exact way in which the samples of acid, glucose, and beer were obtained, along with any letters or other documents relating thereto?—Yes; I shall be pleased to do so.

Dr. ARTHUR PEARSON LUFF, called; and Examined.

Dr.
A. P. Luff

2843. (Chairman.) You are a physician in charge of out-patients, and lecturer on medical jurisprudence and on public health in St. Mary's Hospital, London?—Yes.

2844. And you are one of the scientific analysts to the Home Office?—Yes.

2845. You have had experience of cases of poisoning extending over twenty-five years?—Yes.

2846. Perhaps you will tell us what you know as to the beer poisoning in Manchester?—On November 24th, 1900, I was asked to join the Expert Commission of the Manchester Brewers' Central Association, to inquire into the causes of the poisoning epidemic then prevailing in Manchester, and generally to advise

as to the means to be adopted to immediately stop the epidemic, and to prevent recurrences in the future. I proceeded on November 28th to Manchester, and in conjunction with some of my colleagues, commenced inquiries on the morning of the 29th. I conferred with Dr. Reynolds, Dr. Niven, Dr. Tattersall, and the resident staffs of the Manchester, Crumpsall and Hope Infirmarys, and I wish to place here on record my appreciation of the great assistance so courteously rendered by all those medical gentlemen. The same morning I saw a number of cases of poisoning at the Manchester and Crumpsall Infirmarys, and the same day I reported to a meeting of the Brewers' Association that the majority of the cases I had seen were undoubtedly cases of arsenical poisoning. I under-

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Toxic effect
of arsenic
in beer
influenced
by its great
dilution.

Dr. P. Luff. stand from Dr. Buchanan that I need not repeat what I have mentioned in the next paragraph of my *présis*, as you have already had evidence as to the praiseworthy manner in which the Manchester brewers gave us full powers to act, and did everything possible to stop the epidemic, which I believe was very quickly and effectually stopped. I saw a large number of the poisoning cases at the Manchester Infirmary, the Crumpsall Infirmary, and the Hope Infirmary. The great majority of these cases were undoubtedly cases of arsenical poisoning, but modified by the diluted form in which the poison had been taken, which was of very great importance in connection with this epidemic. The diluted form in which the arsenic was taken was responsible for the symptoms not being quite in line with some of the symptoms of the recorded cases of arsenical poisoning.

2847. Is that because you found more peripheral neuritis than you would have expected if the arsenic had been taken without the beer?—If it had not been taken in so diluted a form, I should have expected more affections of the gastro-intestinal tract, which in my experience were markedly absent, which absence I should expect when the arsenic is taken in so diluted a form. Then I think the symptoms were also modified by the actual amount of arsenic taken, by idiosyncrasy, and probably by the alcohol and other compounds taken in conjunction with the arsenic. I took very careful and exhaustive notes of about forty of the cases. These notes included the symptoms and physical signs exhibited by the patients, the incidence of the symptoms, and the daily amount of beer and spirits consumed. I also obtained from the patients the names of the public-houses at which they usually consumed their beer, or from which they obtained their supplies.

2848. Will you give us a brief summary of the symptoms and physical signs?—In the great majority of cases the illness began with pains and loss of power in the feet, succeeded or preceded by tingling in the soles of the feet, and pain in the calves. In nearly all the cases the extreme tenderness of the calves was a very marked feature. In my opinion it was much more marked than in the cases I have seen of so-called alcoholic neuritis. The peculiar huskiness of the voice was also present in a large number of the patients. Amongst the common early symptoms were also tingling of and loss of sensation in the feet and hands, followed by loss of power and ataxy—that is an inco-ordination in walking and movements with a certain peculiar stepping gait. Pigmentation was one of the marked symptoms amongst the dark complexioned patients, but was only present to a very slight extent among the fair-complexioned individuals. It generally started as an erythema, a scarlatina like blush, on the upper part of the chest, thence spreading to the face and hands. This erythema was followed by pigmentation, which was especially evident in those regions where pigment normally occurs, but was also frequently present all over the body. In some cases the individual almost resembled a mulatto, as regards the colour of the skin, whilst in others the resemblance to a case of Addison's disease was very marked. Of the other skin affections, keratosis, a horny-like thickness of the skin of the feet, and occasionally of the hands, and a reddish rash at the periphery of the soles of the feet and the palms of the hands—erythromelalgia—were met with, with a good deal of pain. I have drawn up a table which is of some interest perhaps as showing the relative occurrence of the different symptoms among the cases of which I personally obtained the histories. That table shows that the commonest symptoms were the symptoms connected with the feet and with the hands. Brown pigmentation occurred in 77 per cent., or about three-fourths of the cases. Colic, vomiting, irritation of the gastro-intestinal tract, were only present in about one-third of the cases, 35 per cent. in each. It is possible that they might have been early symptoms which the patients had forgotten; but my own impression was that the colic and vomiting were perhaps more connected with the excessive amount of beer taken than with the direct action of the arsenic on the gastro-intestinal tract. Diarrhoea was present in only a very small number of cases, although that is a common symptom of acute, or sub-acute, arsenical poisoning. It showed, to my mind, that the arsenic was very quickly absorbed from the gastro-intestinal tract, and that it then produced a peculiar effect upon certain organs, especially on the nervous system, but that it did not produce much direct effect on the gastro-intestinal tract. The following table

shows the different symptoms among the cases of which I personally obtained the histories:—

Pains in the feet	-	-	in 91 per cent. of the cases.
Loss of power in the feet	„	91	„
Tingling of the feet	„	85	„
Pains in the calves	„	86	„
Husky voice	„	86	„
Loss of sensation in the feet	„	82	„
Ataxy	„	82	„
Characteristic gait	„	82	„
Tingling of the feet	„	82	„
Tingling of the hands	„	77	„
Loss of sensation in the hands	„	77	„
Loss of power in the hands	„	77	„
Brown pigmentation	„	77	„
Atrophy of the calves	„	64	„
Dropped hands	„	64	„
Running of the eyes	„	64	„
Anorexia	„	64	„
Absent knee-jerks	„	64	„
Dropped feet	„	60	„
Keratosis	„	55	„
Pains in the hands	„	54	„
Irritation of the eyes	„	50	„
Facial neuralgia	„	50	„
Headache	„	36	„
Colic	„	36	„
Vomiting	„	36	„
Mid-sternal pain	„	36	„
Erythromelalgia	„	32	„
Running of the nose	„	27	„
Erythematous rash	„	27	„
Diarrhoea	„	23	„
Papular rash	„	4	„

2849. I see tingling of the feet twice mentioned, once as 86 per cent. of the cases, and again as 82 per cent. of the cases?—That is so. I ought to explain that that was where it was especially associated with this characteristic gait. I ought to have bracketed that characteristic gait with tingling of the feet, which occurred in 4 per cent. more of the cases where there was no characteristic gait.

2850. Tingling of the feet occurred in 86 per cent., and tingling of the feet, accompanied by characteristic gait, in 82 per cent.—are those the percentages?—Yes.

2851. Are they percentages of a large number of cases.—Of 40 cases. I saw a great many more, but I had not time to take the exhaustive histories that I took of those 40 cases.

2852. (Dr. Whitelegge.) Are all the percentages calculated on the 40?—Yes; all of them.

2853-4. How would the last item, papular rash, 4 per cent., work out in actual cases?—I think that must have been in two cases. I did not go into decimal figures, but I think I must have seen the papular rash in 4 per cent., or two cases. I always kept to entire numbers, and did not go into decimals at all. The amounts of beer admitted to have been taken varied from two pints to fifteen pints per diem, the average being about four to five pints per diem. In one case only was the amount admitted to be below two pints, and that was the case of a female, aged 42 years, who, although most carefully questioned on the subject, would only admit the consumption of two glasses of beer a day, and of four or five glasses on Saturday. I am bound to say I am somewhat sceptical as to the veracity of those statements; but although I questioned her very carefully—and, of course, in connection with our out-patient practice we get into the habit of carefully questioning persons—about the quantities consumed, I could not get her to admit any larger quantity. It is possible her symptoms might have been brought about by that small amount of beer.

2855. (Chairman.) How much would that be?—A glass there is called a gill—it is half a pint.

Dr. A. P. Luff. 15 Mar. 1901. 2856. A glass of beer means half a pint?—Yes. Her case was one of a well-marked peripheral neuritis, together with the characteristic gait, but with an entire absence of either arsenical pigmentation or any arsenical rash. But she was not one of the dark-complexioned individuals.

2857. Would her case be distinguishable from alcoholic neuritis?—Except that the pain in the calves of the legs was much severer than what I have generally found associated with so-called alcoholic neuritis. In only five cases out of the 40 had any spirits been taken for some months, and then, according to the statements of the patients, only in small quantities, and very occasionally. I am of opinion that the alcohol of spirits was not a factor in the production of the peripheral neuritis of any of the cases under consideration. In my experience the cases of arsenical poisoning at Manchester differed somewhat from the chronic arsenical poisoning with which I have been formerly acquainted, such as that caused by arsenical wall papers and by the use of long-continued full medicinal doses of arsenic, in the marked character of the pigmentation and of the skin eruptions in so many of the cases. They also differed from cases of sub-acute arsenical poisoning in the general absence of marked affections of the gastro-intestinal tract. In my opinion the cases should be classed as intermediate between sub-acute arsenical poisoning and chronic arsenical poisoning, as formerly understood. I am also of opinion that most probably the arsenic was taken in such quantities that had the amount been taken in a smaller bulk of fluid sub-acute arsenical poisoning would probably have resulted; but that, being taken in such a large bulk of beer, there occurred a rapid absorption of it from the stomach and intestines and also a rapid elimination of a considerable amount of the arsenic by the kidneys. Another lesson probably taught by the epidemic is that the views hitherto held as to arsenic being a non-accumulative poison, will probably have to be modified. Some of the symptoms point to the fact that the arsenic must have accumulated, and have been retained in the system for a considerable period of time.

2858. (Sir William Church.) Was there anything in the cases that you saw that led you to a suspicion of there being any other poison present but arsenic?—Nothing whatever.

Administration of arsenic and alcohol together.

2859. Have you any opinion whether intemperance is conducive to arsenical poisoning, that is to say, that arsenic taken by intemperate persons acts more severely than on temperate people?—I think it is very probable that it does, but my experience is practically limited to one case that occurred in my hospital practice four or five years ago, where undoubtedly a somewhat intemperate person developed very marked peripheral neuritis after taking only a few doses of arsenic, but I admit that may have been a case of idiosyncrasy. I think it was not, because I then kept that patient under observation in the hospital for some time, when he took no alcohol, and some weeks later, when I resumed the administration of arsenic in the same doses as before, he did not develop peripheral neuritis, when he had undoubtedly recovered to some extent from his condition of alcoholism. That is really the only case I know.

2860. But can you exclude his attack of peripheral neuritis as being alcoholic?—Except that when he came in he showed no signs of peripheral neuritis, and had no alcohol while in hospital, yet after only a few doses of arsenic given in ordinary quantities, 6 minim doses three times a day of Fowler's solution, he developed well-marked peripheral neuritis, and at the time I attributed it to the condition of the nervous system from the result of taking alcohol. He was very readily affected by the arsenic.

2861. But at all events it is not a recognised fact, or the profession have not recognised the fact, that the undue consumption of alcohol predisposes to arsenical poisoning?—No, certainly not. In fact, I did not recall that case until the discussion recently at the Medico-Chirurgical Society, in which I took part.

Question of combination of arsenic with organic matter of beer.

2862. Have you any opinion as to the possibility of the form in which the arsenic may be in beer? Whether it enters into any fresh combination with any organic radicals or substances?—I have no knowledge whatever about that. It is possible it may be in combination with some of the organic constituents, but I have no information on that point.

2863. Do you think that it is necessary to pre-suppose such a thing to account for the effects of these small quantities of arsenic?—Not at all.

Dr. A. P. Luff. 15 Mar. 2854. (Professor Thorpe.) Are they consistent with its being arsenious oxide?—They are entirely consistent with that, in my opinion.

2865. (Sir William Church.) In other cases of arsenical poisoning you have seen, has there been this Symptom extreme tenderness of the calves?—Yes; in some of the cases certainly.

2866. You noted that before the occurrence of this epidemic?—Yes; I had noticed that in arsenical neuritis.

2867. And as being one of the distinguishing points from alcoholic neuritis?—Yes, in my opinion. There is tenderness of the calves of the legs in the so-called alcoholic neuritis, but I have not noticed it of so extreme a character as in arsenical neuritis.

Muscular tenderness

2868. It seemed to me to be most extraordinary in the Liverpool cases?—It was most remarkable in nearly all the cases. I saw patients shriek sometimes if you merely touched them lightly with the fingers on the calves.

2869. Was it very persistent, lasting for a long time?—Yes. I saw some of the cases at intervals of a fortnight, and they still showed the tenderness on pressure.

2870. I saw some of the same cases long afterwards, and they were nearly as tender when I saw them as when you did?—Yes, it lasted a very long time.

2871. To what do you attribute the huskiness of the voice?—I am not sure whether that was not due to some catarrh of the mucous membrane of the larynx, or possibly it may have been due to a nerve cause. I attribute it to one of the two.

Voice affected.

2872. Did you attribute it to the arsenic?—I think very probably it was caused by the arsenic.

2873. You attributed it either to an affection of the mucous membrane or an affection of the nerves of the larynx?—Yes, either to one or the other. This husky voice was so common that I found it in 86 per cent. of the cases.

2874. I see it comes next to the loss of power and tingling in the feet?—Yes. I saw several cases which are not mentioned among the 40 in the out-patient department at Manchester Infirmary which one could almost diagnose by the peculiar glistening appearance and slight running of the eyes, and husky voice alone before one looked at the skin of the chest.

2875. With regard to pigmentation—was it much more marked in dark complexioned people than in fair complexioned people?—Much more.

Pigmentation.

2876. Was it so marked that you think it ought to have attracted the attention of the medical profession generally who saw these cases while the epidemic was in existence at Manchester?—It is so easy to be wise after the event. I am bound to say that I think in my out-patient practice it might very probably have escaped my attention. We do not get the patient to strip as a rule in these cases.

2877. Were not many of them very much pigmented with a pigmentation similar to that which arises from other well-known causes, such as phtheiriasis?—Yes, only in some of the cases pigmentation was darker than I have seen it in any other condition except Addison's disease.

2878. But where it was not so marked could it easily have passed for what we call Vagabond's Disease?—Easily, I think.

2879. Was the distribution of the pigmentation like that in Addison's disease?—No. I never saw any pigmentation inside the mouth, which, of course, one frequently meets with in Addison's disease.

2880. Was it on the skin?—No, it was not similar, because it did not occur at points of pressure where Addison's disease especially occurs. In the women the pigmentation did not show where the pressure of the corset had been, or the garters, as in Addison's disease. There it was quite different.

2881. Were the areolae pigmented?—Always extremely pigmented.

2882. Did you look at the axillae?—Yes, they were extremely pigmented in most of the cases I saw. The pigmentation was generally much darker in the axillae and in the groins than on the chest and abdomen.

2883. And on the pudenda?—Yes. In the main it was always well marked about the penis and scrotum.

2884. In some of the cases I saw, curiously enough, the axillae and groins were less dark than the other surface of the body. That is what made me ask the question?—

In a few cases I found that so, but in the great majority of the cases there was much darker pigmentation in the axillæ and the groins.

1901. 2885. So that, of course, in those cases it did resemble Addison's disease?—It did, except that one did not find it especially marked at points of pressure and on the mucous membrane.

2886. Was the keratosis you saw unique in your experience?—I have never seen it in such a number of cases before.

2887. Or to such an extent?—Nor to such an extent. It was very remarkable in some of the cases.

2888. Greater than you see in some of the ordinary skin diseases?—Much greater in my experience.

2889. That did attract attention at once when these symptoms were manifested?—Yes, that certainly attracted attention.

2890. As soon as cases of keratosis were observed by medical men in Manchester suspicions began to be aroused?—I think it was the combination of the keratosis with the herpes in some of the cases that first aroused suspicion.

2891. Amongst these 40 there seem to be no cases?—None. I saw herpetic eruptions in only three cases, but I think it may have been a fairly early symptom in some cases.

2892. Before the occurrence of this epidemic did you associate alcoholic neuritis with beer?—I must confess that, rightly or wrongly, I associated it much more with spirits than with beer. I did not dissociate it from beer drinking entirely, but I associated it, though I might have been wrong, with spirits rather than with beer.

2893. I suppose you would agree with me that in London most of the spirit drinkers would be probably beer drinkers too?—Yes. I think most of them are undoubtedly so, as far as my experience goes.

2894. (Professor Thorpe.) Did you hear Dr. Tunnicliffe's evidence?—I did.

2895. Are you able to throw any light from your inquiries as to whether there was any tolerance, as it was called, in the Manchester cases?—I am perfectly sure in many cases there was tolerance of arsenic shown. I am quite sure of that.

2896. Then if Dr. Tunnicliffe puts forward as evidence that this mischief is not to be attributable to arsenic alone on the ground of the almost entire absence of tolerance you think that is an unsubstantial ground?—I think so, decidedly. I think anyone who made careful inquiries on the spot would be bound to admit the existence of tolerance in many cases.

2897. Did you think yourself that the marked occurrence of wasting in the Manchester patients occurring independently of gastro-enteritis is to be explained by the specific action of selenious acid alone?—I do not think there was a marked occurrence of wasting. I differ from that statement. There was wasting in some of the cases, but I do not think there was a marked occurrence. There was a wasting in the muscles, which were partially paralysed from the peripheral neuritis, but then you get similar wasting in paralysis from peripheral neuritis of any cause—you must get a similar wasting of the paralysed muscles. Therefore I cannot agree with the statement that there was this marked degree of wasting. If I do not agree with that I could not agree with the deduction as to the selenium being a factor on that account.

2898. If you get well-marked symptoms of arsenical poisoning and you are unable to detect evidence of arsenic in the ingesta what would be your deduction?—I mean if you had well-marked symptoms of arsenical poisoning such as you are accustomed to associate with arsenic?—That you are not probably testing the proper ingesta.

2899. But if you did not find the evidence of arsenic what would be your deduction then?—Possibly that you were not testing all the channels by which arsenic might be introduced into the system.

2900. You would not think the fact that you did not find the arsenic incompatible with the existence of arsenical poisoning?—Not unless it could be conclusively shown there was no possibility of arsenic being taken. But I should want some very conclusive proof that arsenic could not be taken.

2901. Have you had the opportunity of examining any of the materials—the brewing sugars, for instance?—Com. Yes.

2902. Have you caused any of them to be searched for selenium?—None of them.

2903. Of those you have examined did all of them contain arsenic?—No, not all the sugars I have examined. For instance, I examined a number of invert sugars, and only those which had been prepared by Bostock's firm contained arsenic. None of the others contained any whatever.

2904. Have you independently examined them?—Yes, quite independently. I only speak of the actual analyses made by myself. We have not done the work jointly, but quite independently on different samples.

2905. Have you quantitative estimations of the amount of arsenic?—I have in the beers and in the malts, but not in sugars. I did not examine very many of the sugars, only some of those invert ones.

2906. I suppose you have had no samples of oil of vitriol pass through your hands, have you?—No, not through my hands—not connected with this epidemic in any way.

2907. But you have made quantitative estimations, you say, of the beer?—Yes, all of them.

2908. Have you tested the beer itself for selenium?—I have not tested directly, but I think I am in a position to state to the Commission, if they wish for the information, that I believe all these samples of beer to be free from selenium. I can give my reasons for that statement. Although I have not tested directly for selenium I have what I think is a very good reason for believing that selenium is absent in appreciable quantities as compared with the arsenic from all the samples of beers.

2909. Are those beers which were brewed, for example, by Groves and Whitnall?—Several of them. They were beers which were collected in Manchester by inspectors under the Sale of Food and Drugs Act between the 21st November and the 28th December. Several of them were brewed by Groves and Whitnall. I have the names of all the brewers.

2910. What is the evidence, then, that you are able to give us on which you base the supposition that no selenium or selenious compounds were present?—It is this. When this question of selenium cropped up, I saw it stated in that first paper published by Dr. Tunnicliffe that selenium was not to be detected by the Marsh test, and I thought it would be advisable to mix a small quantity of selenious acid with arsenicated beers, and see if it in any way affected the character of the arsenical deposit obtained in the Marsh test. I found to my surprise—because it was quite new to me—that when I added small quantities of selenious acid to arsenical beers or to beers I knew to be pure, to which I also added arsenic, that the character of the deposit by the Marsh test was always entirely different when selenious acid was present. There was a vermilion red character about it. None of the deposits from these beers which were taken between November 21 and December 8 in Manchester show any indication of a vermilion deposit; they are all the pure arsenical deposits such as one gets in the standard tubes when working with known quantities of arsenic. I admit that my experiments are in no sense exhaustive, but it is from that alone that I infer that these beers, which undoubtedly contained arsenic in some considerable quantities, contained no appreciable amount of selenium, although I did not directly test for selenium.

2911-2. (Chairman.) Had you used the Marsh test before the suggestion of selenium was made?—Yes. I was employing that for the so-called estimations of arsenic in beer.

2913. So that you could not have failed to see the brilliant scarlet colours before you were even thinking of selenium?—I conceive not.

2914. (Professor Thorpe.) I suppose the vermilion colour is due to an extremely finely divided selenium?—Either selenium or possibly selenium in combination with arsenic, but I do not know anything about it. I should think most probably it is finely divided selenium itself; it is the colour that one produces by precipitation.

2915. One is, of course, interested to know how it gets there. You will correct me if I am wrong, but if you add selenious acid to the Marsh apparatus, presumably zinc and sulphuric acid?—Yes?

2916. That would form seleniuretted hydrogen?—Yes.

2917. Which would be decomposed by the heat of the tube?—Yes.

2918. Decomposed into hydrogen and selenium?—Yes.

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Chronic
arsenical
poisoning
apart from
the epidemic
symptoms.

Elimination
of arsenic
from the
body.

Toxic effect
of arsenic
and alcohol
together

2919. And the selenium would be deposited in an extremely finely divided condition, giving the red colour you speak of?—Yes.

2920. Is that the theory of the origin of the red colour, do you think?—That is my view of it.

2921. You say that you never noticed this peculiar colour in any Marsh reaction you had previously obtained?—No, not with any of the beers.

2922-3. (Dr. Whitledge.) You have had experience of other cases of chronic arsenical poisoning apart from these?—Yes.

2924. Is the dose, so far as has been ascertained by analysis, unusually small to give rise to symptoms? No, I think not.

2925. You spoke of the clinical appearances being somewhat modified in connection with the epidemic, and you mention as one illustration the absence of gastro-intestinal irritation?—Yes.

2926. Does any other peculiarity suggest itself to you?—No; that was the principal one, the absence of the gastro-intestinal symptoms. I cannot say that I just now recall any other.

2927. There was nothing peculiar in the frequency of the occurrence of peripheral neuritis, for example?—No.

2928. It was not more frequent in connection with these cases than you would expect from the ordinary run of chronic arsenical poisoning?—No; not more frequent.

2929. You say you have had forty cases on which you base your table; were those observed by yourself?—By myself. I have the notes here which I took at the bedside.

2930. Was that at a late period of the epidemic?—These were taken mainly from the 29th November until the beginning of December. I took a great many of these notes on the 29th, and others quite early in December. I could not tell you the exact date now, as I have not the book with me, but I think somewhere about the 3rd or 4th of December.

2931. And the patients who came under your observation would have been drinking arsenical beer for several months?—Very probably, from what we have learned.

2932. Do you think it would have made much difference in the statistics of symptoms if the observation had been made at an earlier period? You mention, for instance, that herpes was an early symptom usually?—When it was observed it was in all probability an early symptom, but I am not prepared to say that herpetic eruptions occurred at all in a large number of the cases; because we were able to question the patients, and they assured us they had never noticed any small water bladders on the skin.

2933. You found brown pigmentation in 77 per cent. of the cases; would you expect, from what you now know of the history of the epidemic, a similar proportion in the early stages amongst the earlier cases?—I should expect to find more erythema in the early stages, because I think the pigmentation succeeds the erythema.

2934. Is it within your knowledge that pigmentation has been less observed in cases occurring outside the Manchester area—in Staffordshire, for example?—I know nothing of that.

2935. Can you give us any information as to the retention of arsenic in the system?—I personally know of one case in which, although the administration of arsenic had been discontinued for six weeks, yet when death occurred at the end of that time arsenic in minute quantities was found in the body. That is the longest period within my personal knowledge, although a case is recorded in which, at the end of fifty days after the discontinuation of the administration of arsenic, arsenic was found in the body.

2936. In any organ?—It was found on that occasion in the bones. It was in connection with the Hyères epidemic.

2937. For how long after the administration of arsenic ceases can you find it in the excreta?—I have not had very extensive personal experience. I found it myself in the urine on one occasion, I think, after six days. I have not got the notes by me. My experience is not at all an extensive one on that point.

2938. Do you attribute an important part to alcohol as predisposing to arsenical manifestations?—I am inclined to, but as I stated to Sir William Church my ex-

perience is rather limited to that one case that occurred about five years ago in my hospital experience; but I am inclined to, because the alcohol would so affect the nervous system as to render it the more susceptible in all probability to the action of the arsenic.

2939. I rather meant in connection with the Manchester epidemic. Do you think that the arsenic *quod* arsenic might not have been able to produce the mischief it did if it had not been for the association with alcohol in beer?—I think that is quite probable.

2940. (Professor Thorpe.) Here are nine Marsh mirrors obtained from nine different brewers in the neighbourhood of Manchester—the beers of nine different brewers. Are those, so far as you can judge, normal Marsh mirrors? (Mirrors shown to Witness.)—I should say these are all normal ones from my experience of mirrors.

2941. So far as you can determine there is no evidence of that vermilion or red deposit which is associated with selenium?—No, I should say that these are normal ones.

2942. (Chairman.) Can you tell us about the quantities of arsenic present in the beers?—I have analysed and specially estimated rather than determined the amount of arsenic present in 24 samples of beers taken in Manchester by inspectors under the Sale of Food and Drugs Act during the latter part of November and the early part of December. The dates are from November 21st to December 8th. Several of the samples were taken on November 21st. The quantities of arsenic present varied from 1-100th of a grain to $\frac{1}{4}$ of a grain per gallon. I can, if it is wished, give the actual amounts for each one.

2943. I think it would be desirable that you should do so?—I will take them in the order in which I have them in my book:— $\frac{1}{4}$ th of a grain per gallon, 1-30th of a grain per gallon, 1-10th of a grain per gallon, 1-25th of a grain per gallon, 1-100th of a grain per gallon, $\frac{1}{4}$ of a grain per gallon, 1-30th of a grain per gallon, 1-100th of a grain per gallon, 1-73rd of a grain per gallon, 1-30th of a grain per gallon, 1-9th of a grain per gallon, 1-20th of a grain per gallon, 1-30th of a grain per gallon, 1-30th of a grain per gallon, 1-40th of a grain per gallon, 1-40th of a grain per gallon, 1-55th of a grain per gallon, 1-42nd of a grain per gallon, 1-50th of a grain per gallon, 1-55th of a grain per gallon, 1-25th of a grain per gallon, 1-55th of a grain per gallon, 1-55th of a grain per gallon, 1-73rd of a grain per gallon.

2944. By what tests did you determine these quantities?—I estimated the amount by the Marsh method. The quantities were not sufficiently large to allow of precipitation and weighing, and therefore it is only an estimation rather than a determination, because one has to compare the mirror with the standard mirrors and so judge somewhat roughly of the amount present.

2945. (Professor Thorpe.) Is that the kind of thing, a series of standard tests, that illustrates what you want to say? (Mirrors shown to Witness.)—Certainly I prepared a number of standard tubes similar to those, and then saw with which tube the mirror I obtained most nearly corresponded.

2946. (Chairman.) Could you distinguish with some degree of confidence between 1-30th of a grain per gallon and 1-40th?—Yes, there is a marked difference.

2947. Could you distinguish between 1-30th and 1-35th?—Yes, but not so accurately.

2948. And between 1-50th and 1-100th of a grain per gallon?—Yes, there is a marked difference.

2949. Would 1-100th of a grain per gallon show a very unmistakable result on the Marsh test with the quantity you used?—Yes. I used 250 c.c. of the beer, and with 1-100th of a grain there is a very distinct deposit.

2950. What was the smallest quantity you stated?—The smallest quantity I found was 1-100th of a grain.

2951. Did every one of them have as much as 1-100th or more?—Most of them had more. There were only two that contained the small quantity of 1-100th.

2952. Were these selected specimens known to be arsenical?—No, not necessarily. They were taken by the inspectors under the Sale of Food and Drugs Act as possibly arsenical beers. These were taken with the object that they might become prosecution cases.

2953. Then were these taken from suspected beers or taken at random from beers suspected and not suspected?—I do not know in what way the inspector

under the Sale of Food and Drugs Act set to work, but he took a number of samples, taking three samples in each case; one was handed over to the public analyst in Manchester, one passed on to me, and the other one retained for reference if necessary to Somerset House.

2954. Have you the means of finding the origins of the beers?—Yes, I have them amongst my notes here—the name of the publican and the brewer and the date.

2955. I think it is very important we should have both names?—May I submit this to you—I am quite in your hands—that these are cases which may become the subject of prosecutions in Manchester. They are simply awaiting a reference to the Higher Court here in London on a point of law. One case was tried and a point of law was raised which has to be argued out here in London, and all these cases may be, of course, subject to prosecutions.

2956. We could have the information, but not for present publication?—Yes, I am perfectly willing to submit it to you. Do you wish me to read it out or submit it in writing afterwards?

2957. It will be better not to read it, but to let us have it in writing?—Certainly.

2958. It will be kept private to the Commission until there is no reason for keeping it private any longer?—I will send it to the Commission.

2959. Do you think any of those specimens were taken from beers outside the number of distinct sources that had been found to be arsenical?—I think these were all taken from public houses amongst which undoubtedly cases of arsenical poisoning had arisen.

2960. Have you ever examined similarly other beers from different quarters?—No, I have not. I have restricted my examinations entirely to these beers. I have not been examining other beers.

2961. (Sir William Church.) These 24 beers were, I imagine, taken from houses to which certain cases had been traced?—Yes, I take it that is so.

2962. So that that accounts for there being arsenic present in every sample?—Yes, I think so. Of course they were taken at the time that the epidemic was just being suspected, on the 21st of November.

2963. (Chairman.) Do you consider that 1-100th of a grain of arsenic in beer could have produced such symptoms as you have described?—I do not.

2964. You think the quantity must have been larger than 1-100th of a grain per gallon to have produced any of these symptoms?—In my opinion it certainly must have been greater than that.

2965. Could 1-50th of a grain per gallon produce such symptoms?—I believe not. I believe that the amount must be over 1-20th of a grain per gallon to be capable of producing any symptoms. It is, of course, only a surmise, but it is based on my knowledge of arsenic and on my knowledge of the administration of arsenic, and I think that the quantity must exceed 1-20th of a grain per gallon to be capable of producing poisoning effects.

2966. (Sir William Church.) Still, the idiosyncrasy of individuals to the action of arsenic is very great?—I would not say it is very great. It is great in a few cases, but it is exceptional, in my experience, to find idiosyncrasy. When you do find it, it may undoubtedly be very great.

2967. We have had evidence given before us that 1-50th of a grain has produced very marked symptoms?—That must have been an exceptional case. The case I know of where a small quantity produced marked symptoms was the one in which 15 minims of Fowler's solution were administered in five 3-minim doses. Fifteen minims would be about 1-7th of a grain.

2968. (Professor Thorpe.) How is tolerance to be explained except on the ground of idiosyncrasy?—I think that tolerance to a drug which is administered repeatedly in small quantities may be acquired in connection with any drug.

2969. (Sir William Church.) Like morphia?—Certainly. A person may get accustomed to any drug if it is administered in small quantities and repeatedly.

2970. (Chairman.) With regard to the quantities contained in a gallon of beer that could produce arsenical poisoning or symptoms of poisoning, that depends, of course, on the amount of beer consumed?—Certainly.

2971. So that with the enormous consumption

which have been unhappily proved to be practised, might not even 1-100th of a grain have been injurious?—No; I do not think even in the case of the heaviest drinkers—and the heaviest drinkers were those who consumed 15 pints a day—I did not come across anyone who took more than that. Of course, there may have been some, but I did not come across any.

2972. A person could not poison himself by 1-100th in a gallon, even by such excess of drinking as 15 pints a day, day after day?—Not in that diluted form, because I think it would be so rapidly eliminated. It would be very different if he took the same amount of arsenic in a smaller bulk of liquid, such as when he is taking it as medicine.

2973. (Sir William Church.) Have you any explanation to offer of there being so many more fatal cases of fatality in the women than in the men?—I think to a certain extent it was that the women, and a good many of them were excessive beer drinkers, were not able to work off the combined effects of the beer and the arsenic as the men did who were employed in heavy labour.

2974. What do you mean by working off the effect?—I myself take it that the alcohol, certainly in some of the cases, in the women predisposed to make the arsenic more active in its effects, especially on the nervous system, and that the women not doing, as the majority of them did not do, any very active work, the alcohol of the beer had a much greater effect upon them than when similar quantities were taken by men employed in actual labour.

2975. The heavy work leading to a free action of the skin and perspiration, you do not think that has anything to do with the elimination of arsenic?—I think it has something to do with the elimination of arsenic. I think certainly arsenic is eliminated by the skin, because large quantities of arsenic have been found in the skin.

2976. Retained in the skin?—Yes, and possibly being eliminated by desquamation. In the scales coming off from the skin large quantities of arsenic have been found.

2977. It is also the case that alcoholic neuritis is more severe in women and more fatal in women, is it not, than in men?—That is so; and again I attribute it to their not taking the amount of exercise and doing the heavy work that men do.

2978. (Chairman.) Then as to the test devised by the expert committee of the Manchester Brewers' Association, have you anything to say about that?—This modification of Reinsch's test was adopted as a result of a series of most carefully-planned and conducted experiments. My experience as to the delicacy and reliability of the test is that for the protection of the public health, and at the same time to allow the brewers to legitimately carry on their trade, it was the best test that could be devised. By means of that test, one part of arsenic by weight in 1,500,000 parts of beer—equivalent to 1-20th of a grain of arsenic per gallon—could readily be detected, and that proportion does not by any means indicate the limits of delicacy of the test. I am of opinion that any beer passed by this test would not, as regards the presence of any minute trace of arsenic in it, cause the slightest harm to persons consuming that beer for a period of several months. I wish to emphasise that I, for one, only intended that test to be a provisional one. We had to deal with an immediate danger, and had to protect as far as we could the public health, and at the same time see that the brewers were not absolutely debarred from supplying their beer. As a provisional test, I considered that that was one which absolutely safeguarded the public, and I stated that beers passed by that test, in my opinion, could do no harm to persons consuming those beers for a period of several months. I do not think it would be right for them to go on consuming it necessarily for years and years.

2979. Might not that test pass beer containing 1-25th of a grain per gallon? You said that this test shows that arsenic to the extent of 1-20th of a grain per gallon could be readily detected.—Yes.

2980. But that proportion does not by any means indicate the limit of delicacy. Might not the ordinary test, applied with ordinary care, overlook the 1-25th? It is valid for 1-20th, but is it valid with ordinary care for 1-25th?—I should say so, decidedly. I know from my own experience that beers have been rejected by

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that test which have contained 1-25th and 1-30th of a grain per gallon.

2981. Would that test reject beer of 1-40th of a grain per gallon applied with moderate care?—It might, and it might not. I am not prepared to say it would, but I am prepared to say that it would absolutely reject a beer containing anything up to 1-20th of a grain per gallon, and I believe up to 1-25th or 1-30th.

2982. Is the danger of the 1-30th of a grain per gallon very slight to moderate drinkers?—I believe very slight, and I believe to immoderate drinkers it would not be productive of ill-effects unless consumed for a very long period of time. This test was, of course, meant as a provisional one.

2983. Do you think that to a person drinking a couple of pints per day that 1-20th of a grain of arsenic per gallon would produce any deleterious effects whatever?—I believe not, not even for a period of some months.

2984. People go on for years drinking beer moderately, and some not moderately?—I am not at all prepared to say that there should be even that amount always tolerated in beer. Of course, our work at the time was to stop a serious epidemic, and to provide a test which would allow of the beer that was being consumed for some little time to come being a safe beer. But I am not prepared at all to say that any arsenic should be permitted in beer.

2985. (Professor Thorpe.) You are not prepared to recommend that test as being, so to say, a statutory test?—Certainly not.

2986. But you put it forward simply as a provisional test?—Only that. It was not, so far as I am concerned, ever meant to be otherwise.

2987. (Chairman.) Have you anything to add to your statement?—I have examined a large number of samples of malt, cokes, and coals for arsenic; but as this work, as well as similar work that is being conducted by my colleagues of the Expert Commission of the Brewers' Association, is not yet completed, I should like to have my evidence on that matter deferred. Before venturing to give any advice as to the best methods of preventing the occurrence of arsenic in beer, it is obviously necessary that we should make ourselves thoroughly acquainted with the various sources, other than brewing sugars, by which arsenic may be introduced, and which, undoubtedly, I am prepared to say is introduced into beers. We are making very exhaustive inquiries. We have been analysing now some hundreds of various things, and we think it would be better to complete all that work before giving evidence on the point.

2988. At present you prefer not to give any evidence with reference to the alleged presence of arsenic in malt?—I am quite prepared to say that I have found it in some samples of malt, and I am prepared to say I found it in one or two samples of malt in quantities which would introduce into beer, if all that arsenic went from the malt into the beer, as malt is ordinarily used in brewing, certainly more than one-twentieth of a grain of arsenic per gallon—that would be from the malt alone.

2989. Have you anything to say as to the prevention of such an outbreak in future?—I should also prefer to defer my evidence, if the Commission would permit me, because that must depend to a great extent from what sources other than brewing sugars arsenic can be introduced into beer; and until we are fully acquainted with the other sources, notably malts, we are not in a position, I consider, to advise as to the best method of prevention. I think I could at once give my opinion as to the best method of preventing it occurring in brewing sugars; but that is not the only source from which arsenic may be introduced, and it is not likely in future to be the source by which arsenic will be introduced into beers. Sugars will be so carefully watched now that arsenic will be detected. But there are undoubtedly other sources which we are looking into.

2990. (Sir William Church.) The malt in which you found a proportion of arsenic which would be represented by more than 1-20th of a grain in a gallon of beer, was that what they call screened and brushed malt?—That was not. I believe that if the malts are screened and brushed there would be very little arsenic left in them. The arsenic is mainly on the surface.

2991. I do not wish to push you in this, but would you say that it is very improbable that with any malt now in the market, if it is properly screened and brushed, more

than 1-20th of a grain per gallon would be introduced into beers?—If it is properly screened and brushed I think it is very improbable that more than that could be introduced.

2992. (Chairman.) Have you made any analysis of the malt dust?—I have not myself, but I got my information from others as to the fact that it is mainly present in the dust, and not in the brushed and screened malt.

2993. (Professor Thorpe.) Are you prepared at this juncture to recommend to us anything in the nature of a test—on what principle this limiting test should be based?—As to whether it should be the Reinsch or the Marsh?

2994. Yes, or some other?—No, I am not prepared to say that, except that in my experience the third test, the Gutzeit, is not a test that can be relied upon—that is my experience of it. I think it will be either the Reinsch or the Marsh, or some modification of either of them, but I am not prepared to say at present.

2995. Here, for example are two tubes. One tube has been prepared in this way. Two-tenths of a milligramme of arsenious oxide, with 200cc. of water, 30cc. of hydrochloric acid, and copper of the dimensions given, have been boiled for 45 minutes, whereby it is assumed that practically the whole of the arsenic will come down upon the copper. The residue was then tested in the Marsh apparatus, and gave the reaction you see there at the top. Do not you think that such a quantity of arsenic ought not to have escaped detection? (Tube shown to witness.)—Yes. I think it is very remarkable, and I am surprised at the amount.

2996. (Chairman.) Boiling for 45 minutes with the Reinsch test did not take out all the arsenic?—No, apparently not. We never thought it would take all of it out, but we knew it would take out sufficient to detect up to that limit.

2997. By continuing the boiling with a fresh piece of copper would you be able to take out more?—Undoubtedly.

2998. Could it all be got out in that way by going on long enough?—I doubt if it is all removed. I have not experimented on that point, but I doubt if it is ever all removed by boiling, unless you get it down in bulk, and continue to add more hydrochloric acid. I am surprised that so much arsenic is left in this tube.

2999. (Professor Thorpe.) Here are two actual beers, with an unknown quantity of arsenic, which were boiled for 45 minutes, according to prescribed conditions, and then the residue was tested in the Marsh apparatus, and gave those results. Do not you think that is an amount of arsenic which ought not to have escaped detection?—I certainly think so. May I ask what sort of sublimate was obtained from the copper; was it a well-marked crystalline sublimate?

3000. I am not able to tell you?—This does not indicate that the test was not a good one, unless it can be shown that the sublimate, as obtained from the copper, was one which would have allowed the beer to have been passed as a safe one. I am prepared to say that, although this amount was left in the beer, yet there would have been a very good sublimate obtained from the copper, which would be quite sufficient to condemn that beer.

3001. That may be true, but the point is that the copper did not take out anything like the amount of arsenic that was present?—No; but in Reinsch's test it never does. What we said in connection with this test was that it took out sufficient always to indicate if the beer contained anything like 1-20th of a grain, or more than that, per gallon.

3002. (Chairman.) Has it ever been tried to use a large number of pieces of copper simultaneously in the Reinsch test?—Yes; but that is not desirable. It is far better to concentrate the arsenic upon a small piece of copper.

3003. If you use two pieces of copper in the Reinsch test, will each of them take less than one alone would have taken in the same time of boiling? Supposing you took a piece of copper of a certain size, and boiled it for three-quarters of an hour, repeating it again with all the circumstances the same with two pieces of copper, will each piece of copper take as much in the test as the one piece of copper in the previous test?—No; you will not get so much deposit on each of the two pieces as on the one, but possibly you may get rather more deposit on the two pieces together. We never thought that this test removed all the arsenic, but we found by experiment that it removed sufficient

Further
work of
Brewers'
Expert Com-
mittee.

Arsenic in
malt.

Dr. P. Luff. to enable the beer to be condemned, certainly up to the limit of 1-20th of a grain per gallon, and even more.

3004. (Professor Thorpe.) In other words, your test is a net of which the meshes are still rather large?—Certainly.

3005. (Sir William Church.) You asked Professor Thorpe, and he was unable to tell you, the condition of the copper by which the beer was tested: if that beer had contained a large amount, say 1-10th of a grain, you would have got such a precipitate upon the copper that you would have been able to reject the beer from that without using the Marsh test at all,

would not you?—From our experiments we know that if beer contained anything like that, whatever the amount or arsenic that might be left in the beer after boiling with the copper, there was always enough deposit on the copper to condemn the beer.

3006. Would you condemn it on the deposit on the copper?—Certainly. I knew there was some left, but I was surprised to see from those mirrors that it was so much. There is no doubt, however, in my mind but what those beers would have been condemned by the subliming from the copper, whatever amount of arsenic was found afterwards in the beer.

Dr. A. P. Luff.
15 Mar. 1901

SEVENTH DAY.

AT THE TOWN HALL, MANCHESTER.

Monday, 25th March, 1901.

PRESENT:

The Right Hon. Sir WILLIAM HAERT-DYKE (in the Chair).

Sir WILLIAM CHURCH.

Professor THORPE.

Dr. WHITELEGGE.

Dr. BUCHANAN, *Secretary*.

Mr. RICHARD GEORGE HOOPER TOMSON, called; and Examined.

G. H.
1901.

3007. (Chairman.) You are secretary, are you not, to Messrs. Threlfall's Brewery?—No. I am the manager of the Manchester business.

3008. You are the first witness taken in Manchester for this local enquiry, and you wish to say that the reference that has been made in one of the papers to obstacles having been placed in the way of the Commission obtaining information is inaccurate?—Yes, certainly.

3009. How many years have you been in this responsible position?—I joined Threlfall's Brewery in 1864, and have been there ever since.

3010. As secretary all that period?—No. I joined first of all in Liverpool as one of the junior clerks, and from there I was transferred to Manchester in 1865, and I was quite a young man when I was put into the foremost position there. Our old cashier fell ill, and I have been in the principal position ever since, and really had the practical management of the business. I have had very nearly 40 years' experience.

3011. Messrs. Threlfall's Brewery are customers of Messrs. Bostock, are they not?—Yes, we have been customers of Bostock for certainly 15 years, if not longer—it may be 18 years.

3012. Is glucose used in your brewery?—No; we have not used any glucose at all of any kind or description; we have only used the two qualities of invert sugar. Garton Hill's and Bostock's, and in both instances it is the No. 1 quality, the best quality we could buy.

3013. Have you ever had any other than the best quality supplied to you?—No.

3014. Has this invert sugar that has been used in the brewery been used for brewing only, or priming, or for both?—We use it principally in the brewing, in the copper. We have primed, but only to a very small extent. 76 per cent. of our brews are unprimed, and 24 per cent. have had priming in them. That 24 per cent. is sub-divided into this: 10½ per cent. with only a quart to a barrel, and 13½ with two quarts to a barrel.

3015. Those proportions you have mentioned were in use in the brewery between June and November last?—Yes.

3016. There was no exception at that time to the usual course?—No. We have used both these sugars

practically in the same proportions for many years past.

3017. With regard to different qualities of beers, which quality of beer were you in the habit of priming, and how much priming did you use in each kind of beer?—In the 8d. beers there has been no priming whatever, but in the other beers, where they have been primed, it is only used to the extent of about a quart in the best ales and two quarts in some of the common ales. That is only in a small proportion of the brews. There is very little priming in the bitter beers. It is principally in the common beers, the 6d. and 4d. beers, but even then it is only 24 per cent, that is, 76 per cent. has not been primed at all.

3017*. (Professor Thorpe.) In priming, do you use the amount which the Excise permit you to use, or less?—Limit of priming.

3018. What proportion of the permissible amount do you use?—The quart would be about half the permissible amount.

3019. In no case greater?—No, in no case greater than the Excise allows.

3020. In no case greater than the proportion, I mean?—It depends upon how you treat it; you can use this priming to any extent if you only treat it as a "wort."

3021. As a separate brew?—Yes.

3022. Confining ourselves to the syrup for a moment?—We have never exceeded what the Excise allows.

3023. What proportion of the amount that the Excise allows you have you uniformly worked up to?—That depends entirely how you treat it. If you call it "syrup" they will not allow you to use more than something under a half gallon. If you take exactly the same solution in every respect, and treat it as a "wort" you can use any quantity of it. Excise limit may be exceeded if priming is termed "wort."

3024. Of course I know that, but I think perhaps it may serve to fix our ideas if we dissociate the two operations. You can use any amount of sugar you please when you enter it as a brew and declare the gravity of it?—Yes; that is for priming. I am not speaking of the copper.

3025. The finished beer you are allowed to add a certain amount of syrup to?—Yes.

3026. We will keep those two things different. In your 8d. beer you added no priming?—None at all.

Mr. E. G. H. 3027. In your cheaper kinds of beers you added a certain amount just before it went out?—Yes, in 24 per cent.

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3028. Of the 24 per cent. which you primed immediately before it went out with syrup, did you invariably use the amount which the Excise permits you to use?—No, less.

3029. How much less?—A quart. It would be something under two quarts they would allow. It is about three pints, I think.

Sugar obtained from another maker besides Bostock.

3030. Was that syrup invariably Bostock's?—No, Garton Hill's.

3031. Invariably Garton Hill's?—Yes.

3032. Invariably for that purpose?—Yes.

3033. (Chairman.) Taking all the sugar in use, how much during the period you have mentioned came from Bostock's?—I think about 12½ per cent. of Bostock's and 7½ per cent. Garton Hill's.

3034. For how many years had your firm been a customer of Messrs. Bostock?—15 to 18 years; I should think it must be the latter.

3035. And until this epidemic arose had either you personally or the firm in general any reason to suspect that there was any mischief?—None whatever. I have been in the trade all my life, and my father was, and my grandfather, and I never heard of such a thing before. It came upon us like a thunderclap.

3036. You had never the faintest suspicion?—No, not the slightest.

Action by Brewery on discovery of epidemic.

3037. Will you tell the Commission, after this discovery was made, and as soon as it was ascertained there was any danger, what steps generally were taken by your firm for the security of the consumer?—The first communication we had that there was anything really seriously wrong was from Dr. Tattersall, of Salford. He wrote on the 21st November, and asked to be supplied with samples of our malt and hops, which were, of course, sent to him. We did not hear anything more until the 23rd, on the Friday, when he said he had found nothing wrong with the malt and hops, and asked to be supplied with samples of the sugars. We also sent those. On the 24th he sent down word again that we had better stop using Bostock's sugar. Of course I went with the brewers, and we had all the stock of Bostock's put on one side, and I had the casks sealed so that they could not be used. Eventually, of course, it was all returned to the works; every barrel was sent back.

3038. Did you recover all the beer that went out to the retailers?—Yes. We stopped the use of the sugar. I am speaking of the sugar now; it comes in in barrels, and I had them sealed and sent them all back.

3039. That was the security for the sugar?—Yes.

3040. (Professor Thorpe.) Did you send to Dr. Tattersall at the same time Garton Hill's sugar?—Yes.

3041. You yourself had no idea which sugars were incriminated?—Not at all.

3042. You sent both?—Yes.

3043. And the only message you got was: Stop using Bostock's?—Yes.

Prosecution under F. and D. Acts.

3044. (Chairman.) With regard to your beer, in the first place, has any action been taken by the sanitary authority against any retailer?—Yes; 5 summonses were issued against our retailers in Manchester only, and two of those samples were taken on the 21st November, before we knew anything about it.

3045. At what dates were the summonses issued?—I think they were returnable on January 7th or 8th.

3046. With regard to the suspected beer containing this contaminated sugar, I presume a great quantity had gone out, had it not?—There was a large quantity in the retailers' cellars. They have to have quite a week or 10 days' stock in most of the houses.

3047. What steps did you take with regard to the houses?—It was on the 26th, the Monday; when I got to the office I stopped sending all the beer out, stopped the sales absolutely straight away. Our managing director came over on Tuesday, and we divided Manchester and Salford up into districts. We send our beers into a great number of towns and it was a work of no small labour—there are about 40 different towns we send our beer to. We stopped the whole of the beer with Bostock's sugar in it in Manchester and Salford by sending messengers round, and in the outlying districts, Oldham, Bolton, and those too far to reach

by messenger were informed by telegrams. It cost us something between £5 and £7 for telegrams.

3048. With what result?—Every barrel was suspended. We stopped the sale first, and then a day or two afterwards we sent round and had it all destroyed.

3049. Do you know within a little what the quantity was?—I can give you the exact figures: there were altogether 5,558 barrels.

3050. Was it destroyed on your premises or both on the premises and elsewhere?—Yes, both. The consideration that weighed with us was, as I say, the fact that a large quantity of our trade is done outside Manchester and Salford. There was one thing perfectly clear, that the beer was utterly valueless, and to pay the carriage back from the outlying districts where we delivered by rail, and haul it back from Oldham, Bolton, and other districts, would be only giving an immense amount of manual labour. In some cellars it is awkward to pull ale out. We took into consideration that it was no use, and therefore destroyed it in the customers' cellars. We did not leave it to the customers to destroy; we saw it run down and destroyed ourselves in each instance.

3051. (Sir William Church.) Your agents went to all the houses you supply?—That is so.

3052. (Professor Thorpe.) You had no reason to take it back. What object had you?—It was absolutely valueless to bring it back; to haul it back from Oldham, Bolton, and all those places merely for the sake of destroying it would have been foolish.

3053. The beer having left the premises, you could not consider you had any call upon the Excise authorities to refund to you?—No, we found we could not do that; it would not do to have risked it. It would have been too great a risk, and would not have been worth the candle.

3054. (Chairman.) That would have created an interval of time which would have caused danger?—Yes.

3055. (Dr. Whitelegge.) Do the 5,000 barrels include any quantity destroyed at your own works?—Yes. There was rather more I think destroyed at customers, perhaps two or three hundred barrels more than in the works.

3056. (Chairman.) In consequence of this catastrophe, I presume more than ordinary steps have been taken by your firm since to prevent the recurrence of such a disaster. Could you tell the Commission what those steps are which have been taken since?—Yes. We sent every sample of ale out to be analysed. We sent some to Matthews and Lot, and a sample of every malt and hops, and ingredient that we had, and also sent samples of the ales; and they sent a telegram to us that we must stop using Bostock's. They passed all the samples of beer with the exception of one, which they said contained a faint trace of arsenic. We sent samples to Dr. Miller, who was very much more severe. He said there were some of the beers contaminated. Those were all destroyed. Those were the beers we did not send out.

3057. (Sir William Church.) These are in addition to the 5,558?—No; they are included.

3058. (Chairman.) My question rather referred to what steps you have taken since. You are referring now to everything you had in stock?—Yes.

3059. The point I was putting to you is this: since the catastrophe and the steps you then took for the destruction of your beer, what steps have you taken so as to secure absolute purity from arsenic?—We have not sent a single barrel out since December 3rd but what has been passed by Dr. Miller. He is analysing now every brew we send out. We have not parted with a single brew that has not been passed by Dr. Miller. We also sent all samples of ingredients, malts, and hops, and sugars to be analysed by him.

3060. (Dr. Whitelegge.) What does Dr. Miller report to you?—Of the beers now?

3061. Yes. In what terms does he report? Does he say "Free from Arsenic," or "This beer may be distributed"?—I have his reports here. He states that such and such a sample of beer "readily passes the experts' test"—i.e., the test recommended by the expert committee of the Manchester Brewers' Association, which you have had in evidence.

3062. (Professor Thorpe.) Are the reports all constructed on the same formula?—Just about the same.

3063. (Chairman.) Is that a general type?—Yes. There is one very important analysis there the Commission might like to see. We had that done the other day.

G. H. "Messrs. Threlfall's Brewery Coy. Ltd., Manchester.

9th March 1901.

1901. "Dear Sirs,

I have tested for arsenic the following of your samples, and the results are as under:—

Sample marked P.A.	First wort, passes easily.
" "	P.A. Last runnings, passes easily.
" "	P.A. From hop back, passes easily.
" "	P.A. From cooler, passes easily.
" "	P.A. From round without yeast, passes easily.
" "	P.A. 351. First morning after fermentation, passes easily.
" "	B. First wort, passes easily.
" "	B. Last runnings, passes easily.
" "	B. From hop back, passes easily.
" "	B. From coolers, passes easily.
" "	B. From round without yeast, passes easily.
" "	B. 552. First morning after fermentation, passes easily.

Yours faithfully,

ALEX. K. MILLER."

3064. This is an analysis of samples?—That is what we call "Coursing the Brew right through." We do it in every stage. It gives the process which it goes through. We had, I think, two brews done in that way.

3065. (Professor Thorpe.) Is that a brew in which you use malt substitutes?—Yes; I think it had Garton Hill's sugar in it.

3066. (Sir William Church.) Do you know what Dr. Miller means by the term "pure" in some of these certificates?—I suppose it is that it has passed the test laid down by the experts.

3067. No. He said "Readily passes the expert test" in the case of three beers, and in three other cases he says it is "pure"?—I cannot explain that.

3068. (Chairman.) The one is the finished article, beer, and the other, which he terms "pure," is an ingredient, namely, malt?—Yes. He has used that formula all through.

3069. There are two formulæ, one for the finished article and another for the ingredient?—Yes.

3070. Up to the time of this disaster, what steps were your firm in the habit of taking in regard to analysis generally of your product, or of any sample which you were using?—We had the water analyses periodically, and I have the analysis here.

3071. I am referring to the time before November, of course?—Yes, before November, 1900. The last time we had Bostock's analysed was in July.

3072. Have you an analyst?—No.

3073. (Professor Thorpe.) You had Bostock's sugar examined so far back as July?—Yes.

3074. What would you have it examined for then?—Because we usually do have things examined.

3075. But for what purpose?—To see if there is any constituent in it that is objectionable for brewing purposes. We should never dream of having it analysed for arsenic. Arsenic is a matter that is not of the least value to us; it neither helps us, nor is it a detriment. I am putting aside the poisonous quality. But as a matter of help or defect in brewing, we do not care whether it is in or out. When we make the analyses we do so for the purpose of finding out any ingredient that would be helpful to brewing, or harmful to brewing.

3076. (Professor Thorpe.) What you mean is, you examined Bostock's "invert" for its brewing value and nothing else?—Yes.

3077. (Dr. Whitelegge.) So that the analysis in July would not throw any light in one way or the other on arsenic?—No. Dr. Miller came to my office and had an interview with our managing director. I was present. He put the question straight to Dr. Miller. He said: "How was it you did not find arsenic," and he said, "I never looked for it."

3078. (Chairman.) He never tested for it?—No.

3079. (Professor Thorpe.) It was Dr. Miller who examined it in July, was it?—Yes.

3080. (Chairman.) Now this epidemic has taken place, of course you would not be satisfied, as regards future analysis, with the test you have applied in the past—you want something of a different type?—Yes.

3081. Can you suggest, from practical experience and connection with the trade, what test should be applied not only to the materials, but to the finished article in the future to give complete security against arsenical poisoning?—I do not think I am able to do that.

3082. We do not want you to speak as a practical chemist, for instance; but merely from your trade connection?—Our brewer submits it, roughly speaking, to a rough test. Touching Bostock's sugar, I remember in 1899, nearly two years ago, just about the end of May, that in putting this through the rough test he discovered something he did not like. He sent that sample to Dr. Miller to be analysed, and the report came down that the sample contained a portion of cane sugar. The invert sugar of Bostock's is made from cane sugar, and it really meant that it had not been properly inverted. The effect would be that it would cause the beers to be thick, and that was distinctly detrimental to brewing. It would have spoilt our beers. We stopped using it for a time. We had Major Pooley, who was chairman of Bostock's at the time, down, and he got a pretty good dressing down from our managing-director about it. Lately Bostock's sugar as far as the brewing sugar is concerned, has been good—our brewer was only telling me last spring the excellent quality they were sending us. There was practically little to choose between them and Garton Hill's as far as the brewing sugar was concerned. Garton Hill's was simply lighter in colour, and more adaptable for pale ale brewing.

3083. (Chairman.) Does that suggest there was something wrong that you sent this for analysis? It was not your habit to subject these materials to constant analysis?—Every now and again we sent them up.

3084. You were satisfied with an occasional test?—Yes. I believe Garton Hill's was analysed some time in 1898, but we never found the slightest thing wrong with Garton Hill's, and we have dealt with them longer than with Bostock's.

3085. (Sir William Church.) To put it very shortly, your purpose in having Bostock's material analysed was to see that it was not adulterated, that it contained nothing that it should not contain?—That is precisely so.

3086. (Chairman.) Would you be satisfied in the future—I am speaking now as regards carrying on your business so as to get perfect security against any danger of this kind occurring again—would you be satisfied with a guarantee as regards each one of these materials from the manufacturer?—No; we get the guarantees. I have them here. (Witness put in guarantees of malts, brewing sugars, etc., which stated in each instance that these materials were "free from arsenic," "absolutely pure," or "perfectly free from arsenic or other deleterious ingredients.")

3087. Would you propose in the future that in addition to the guarantee you should apply the test of analysis on your own premises?—It will very likely lead to it. In brewing our beer we are never very much in love with too much chemist, and if we require analysing we send it up to London, or get an analyst outside to do the work. I think now it will eventually come to it that we shall have to have analysts. We have two young pupils coming up from Dr. Miller, one being my son, and I think we shall put down a laboratory, and submit the beers to an analytical test. If there is anything suspected we shall have it further corroborated by some higher expert. These are the sort of things we get now. (Specimen analyses of brewing sugars put in.)

3088. From what you know of the trade generally, do you think it would be considered injurious to their business if they were compelled to test each and all materials, in addition to having the guarantee of their purity before using them?—I do not know why it should, provided the test is a fair one.

3089. I am assuming, of course, a fair test. My point is, whether you think it would be injurious to the trade, or cause any very great extra expense in the course of your business if you were obliged to apply a secure test in each case as regards the materials you are using—say, for instance, invert sugar—that that invert sugar is absolutely pure from arsenic, before it comes into your business?—I do not think it would be, and I do think it ought to be done.

3090. In fact from your recent experience and all your firm has gone through, you would be almost inclined to do it for yourselves rather than run such another risk; that is your feeling at present?—Undoubtedly so. It might press a little bit hardly on the smaller brewers, but I do not know.

Mr. R. G. H.
Tomson.
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Mr. R. G. H. Tomson. 3091-2. You buy malts now under a guarantee that they are free from arsenic?—That is so.

25 Mar. 1901. 3093. You would not object to a separate guarantee for each consignment?—No; but we get them.

Arsenic in non-Bostock beer. 3094. After giving up the use of Bostock's products were any of your beers condemned as arsenical either by your own analyst or by others?—Yes; in three instances we found traces. Dr. Miller reported there were minute traces in three of the brews.

3095. Was that beer brewed from invert sugar or glucose?—We never use glucose. I believe in one instance it was an all-malt brew, and in the others invert sugar.

3096. Did you find it necessary to destroy these?—I do not know whether it was necessary to do it, but we did it.

3097. In your brewery do you malt for your own purposes, or buy malt largely?—We malt rather more than half, and the rest we buy.

3098. With regard to the malt you buy, I suppose you have regular people you deal with?—We buy our malt uniformly from one or two people.

3099. Can you tell the Commission who these people are?—Jones, of Shrewsbury, and Soames, of Grimsby.

3100. (Dr. Whitelegge.) Where are your own maltings?—At Worksop, Horncastle, and a small one at Lincoln.

3101. Have you any knowledge of the working of these places?—Yes, I know the process of malting. Of course I am not an expert maltster; I used to learn something about the process some years ago.

Coke abandoned by maltster. 3102. Do you know how the malt is dried?—Yes. In our kilns we used coke.

3103. (Chairman.) Do you use coke now?—We have stopped it now.

3104. When did you stop it?—After this matter came up.

3105. Before that you had always used it, had you?—Yes, principally, I believe.

3106. What are you using now?—Anthracite.

3107. I suppose the Manchester and Salford brewers use a great quantity of malt, do they not, as well as sugar?—Yes; it is the bulk of it.

3108. Can you tell the Commission where the chief part of the malt comes from?—No, I could not answer that.

3109. You could not say personally what was malted on the premises?—I do not quite follow you. Do you mean to say, brewers using their own malt?

3110. Yes?—I have no knowledge of that.

3111. (Professor Thorpe.) Is there much malting done in this district?—No. It will come more from Grantham, Lincolnshire, and that way. There is a great deal of malt from the Yorkshire district.

3112. (Chairman.) There is a great deal of malting in Norfolk, is there not?—Yes. At one time we used to malt practically all our own, but the trade has so increased that it has outstripped the malting supply.

3113. You now malt about 50 per cent.?—I daresay 45 to 55 per cent.

3114. (Professor Thorpe.) Has that malt been usually dried with coke or with anthracite?—Usually with coke.

3115. Hitherto it has been mainly dried with coke?—Yes.

3116. (Chairman.) Had you had any suspicion until lately that it was possible for malt to become impregnated with arsenic from the fumes of the coke?—It was not known to me, or to any of us.

3117. Do you suppose, taking the trade throughout the United Kingdom, there was any suspicion whatever?—Not in the least.

3118. Or, as regards any brewer, that there was that danger in the business?—No; I have never heard of it, or heard it hinted at in any way.

Guarantees in respect of malt.

3119. (Dr. Whitelegge.) Do you demand a certificate for the malt you buy to the effect that it has been dried with anthracite?—I do not know that we actually stipulate.

3120. It is mentioned in two of the certificates you have handed in?—I do not think we have gone so far as to say, "This must be dried with anthracite," but we take it that it is, because we have a certificate of purity.

3121. From arsenic?—Yes.

3122. (Professor Thorpe.) Have you had any difficulty about getting the certificates in the case of malt?—No.

3123. Have you insisted upon them, or have they been volunteered?—We have insisted upon them. I may say there are one or two samples which after buying we had analysed, and there was a very faint trace, and we would not even use them.

3124. Has the necessity of drying with anthracite affected the price of malt?—I do not think it has. It will naturally affect the price a little, because it is more expensive to use anthracite coal.

3125. Do you anticipate that will be the effect?—Yes; I daresay it will put it up slightly. It is rather a difficult thing to arrive at; of course, it does add to the cost, but whether it will be sufficient for the maltster to bear the loss of it or whether he will put it on to the consumer I do not quite know. There is a great deal of irregularity in the way the malt comes in; sometimes it is a maltster's year and sometimes a brewer's. It depends on the grain.

3126. (Chairman.) It will depend upon the locality also, as regards the price between the anthracite and coke?—Yes. There is the cost of the carriage.

3127. If anthracite were to be used solely for malting I presume it might stop malting in some districts, and it would go on in others where anthracite was more easily procurable?—It might be so, but I could not answer that question very well.

3128. (Dr. Whitelegge.) Have you any knowledge of malt samples dried by means of gas coke which have been analysed and found free from arsenic?—Some of them have.

3129. Recently?—We have had some samples passed, but it all depends upon what test they were put through. It might not have been so severe a test as they are using now.

3130. Do you mean some of the samples recently supplied to you?—No, not recently supplied.

3131. Unless they were recently supplied they would not have been examined for arsenic?—Do you mean since December?

3132. Since you have been in the habit of referring them to Dr. Miller for analysis?—In the early part of December we had some samples of the kind in question sent out for analysis.

3133. Were they passed by Dr. Miller?—No, Mathews and Lot passed them, I think.

3134. Do you remember where they came from?—Yes, Worksop and Horncastle.

3135. Would it be your own maltings?—Yes.

3136. And while you were still using gas coke?—Yes.

3137. But in spite of that you changed from the gas coke to the anthracite?—What we did was this. As soon as we had these unfavourable reports of the malt I went over with Dr. Tattersall. He asked to see our maltings and he took some samples away. We stopped malting and had the whole of the kilns cleaned down, and have been using anthracite, and since then all the samples of malt we have had have been passed as pure.

3138. (Chairman.) When you speak of cleaning the kilns that means that a large amount of malt dust has collected?—Yes.

3139. That would point to the importance in the future of keeping these kilns as free as possible from the collection of malt dust?—Yes. I do not know how you are going to do that. They are always brushed up and thoroughly cleaned every now and again; but for all that there will be a certain amount of dust there.

3140. With regard to the materials you use in the manufacture of beer, do your books show what particular materials were used in the manufacture of any particular beer, and in what quantities?—Yes. I brought up our brewing book. We have a record of these things. That is the system. (Books shown to the Commission and explained by the Witness.) This is the date, the number of the brew, and the quality. These are the quantities of malt in that particular brew; these are the hops used; these are the details, and these the number of barrels produced. The number of barrels produced are the bulk barrels; they are taken by the Excise and reduced to the gravity.

3141. (Professor Thorpe.) Is this the form prescribed by the Inland Revenue?—No, it is our own private book.

3142. (Chairman.) This includes all the information

Brewer books ingredients of each

but not land Re returns

2. G. H. tion to the Inland Revenue that is required?—Yes.
 olson. We do not give the different malts here; but in
 ar. 1901. this other book we give the different malts. (*Book shown
 to the Commission.*)

3143. With regard to your tied houses do you always
 know what brews are on the premises at any given
 moment?—Yes. The casks are all numbered.

antee of 3144. With regard to the retailer do you give a
 y to guarantee of purity in each case?—No; we have never
 er. done it.

3145. If a severe system of testing were necessary in
 the future, I suppose you would be only too glad after
 the test had been applied to have it placed on the barrel
 or bottle?—I do not see any objection to it.

3146. Having gone to the extra expense, small or
 great, of testing accurately so as to secure purity, you
 would have no objection to advertising the fact that
 such test had been applied and that it was guaranteed
 pure?—I do not see what objection could be raised to
 it as long as the beer was pure.

3147. My point is this: a guarantee might prove falla-
 cious, might it not?—Yes.

3148. A guarantee of a certain material under which
 you buy might be fallacious, might it not?—It might
 be, certainly; it is possible.

3149. If you apply a severe test on the top of that
 as an additional security to the consumer, you would
 have no objection to its being advertised on the barrel?
 —Yes. Certified as pure.

3150. (*Professor Thorpe.*) But publicly certified?—
 Yes.

3151. (*Chairman.*) Have you taken any steps in ap-
 plying to the Inland Revenue for return of duty on any
 beer?—We thought of doing it, and we stored the beer
 that had not been sent out, but eventually we decided
 not to do it, and ran it all away. What weighed with
 us in that respect was that we thought there would be
 a great deal of trouble in getting it, and the casks were
 suffering. It was no use getting 5s. or 6s. a barrel
 back in the case of a cask worth double the money. We
 thought therefore it was best to destroy the beer and
 save the casks.

3152. (*Professor Thorpe.*) You called in the Revenue
 officer to take note of the volume?—We notified him,
 but I do not think he attended.

3153. I gather you do not now intend to make a
 claim?—No.

3154. (*Sir William Church.*) What length of time do
 you think elapsed between your becoming aware of there
 being contaminated beer in the tied house and all of it
 being destroyed? It must have taken some time for
 you to go to all the houses. You say you sent telegrams
 to stop the sale of it, and then sent your own agents
 round to destroy it?—I should think that within a
 week it would be very nearly all destroyed. There
 might have been a few barrels left, but very few.

3155. Before it was found out that beer was contami-
 nated by arsenic, did you ever have your malt analysed?
 —I do not remember ever having it submitted to an
 analyst such as we have had done lately. We examined
 the malts, but it was more for moulds, sickness, broken
 corns, or anything of that sort.

3156. Analysed for its quality but not for any im-
 purities?—No, not for any impurities.

3157. Used you to have any other brewing materials
 analysed?—No.

3158. Did you use hop substitutes?—No.

3159. Did you use colouring malts or have them
 analysed?—No; we did not use colouring materials,
 except in porter brewing.

3160. Were the preservatives analysed?—We used
 phylax, but I do not know we ever had that analysed
 until this was brought up.

3161. Do you know in what way the materials that
 you got from Shrewsbury were dried?—Yes; they are
 all dried by anthracite coal.

3162. I presume the Grimsby malt would be probably
 dried with coke?—I think now they are dried with
 anthracite.

3163. What I am asking about is, whether you could
 give the Commission any information as to the custom
 previously?—I believe Jones has always used anthracite
 coal, but what Soames have done I cannot say.

3164. Have you any knowledge of the kind of fuel
 that is chiefly used in Norfolk?—No, I have not. I
 suppose they do there the same as at other kilns.

3165. It was quite unsuspected by maltsters generally
 that there was the possibility of this danger?—I never
 heard of such a thing.

3166. In your own malting do you clean the malt
 after it had been roasted?—Yes. We screen it. It malt
 always was screened, and of course it is screened again
 when it is going into the hopper for crushing. All the
 dust is separated, but now we are having it double
 screened.

3167. I wish to know something about what was the
 habit of the trade before there was any suspicion of the
 possibility of this outbreak occurring?—It was all
 screened, and a great deal of the malt dust and foreign
 substance taken out, but it was not absolutely all
 cleaned. The remainder of it was done when it was
 passing through the mills. The mills we use are
 Nalder's mills, wonderful machines. They can separate
 all the dust out, and they can take nails or any stones
 out, and only leave the malt in.

3168. Were you always in the habit of screening?—
 Yes. You could not use malt without.

3169. But not as effectually as is now done. There is
 what they call brushing as well as screening?—We are now about
 now erecting machines in our kilns for that purpose. be adopted.
 We have never tried it. It is quite a new thing.

3170. Polishing has been only recently introduced in
 the malting?—Yes; it is a very recent addition. We
 never heard of it before this happened.

3171. Do you think this extra screening and polishing
 has been used by other maltsters for any time?—That
 I am unable to say.

3172. The malt you used to buy was also, I presume,
 screened?—Yes, it would be all screened.

3173. Was it satisfactorily screened?—Yes; we never
 had any fault to find.

3174. Do you know whether that was polished?—I
 should say not.

3175. (*Professor Thorpe.*) I think you told us that of
 the two sugars that you are in the habit of using, Bos-
 tock's and Garton Hill's, in your opinion there was
 practically no difference in their equivalent brewing
 value?—That is so.

3176. But such difference as there was was that Bos-
 tock's were inclined to be rather darker in colour?—
 That is so; it was always that way. Garton Hill's was
 always an exceptionally pale syrup.

3177. For example, would you call that dark in colour
 or light in colour (*sample shown to Witness*)?—I should
 call that a light colour.

3178. Was Bostock's usually darker than that?—I
 should think so, a little.

3179. Was Bostock's darker than that of late, or was
 it always very much of the same character?—Always
 very much of the same character. You are asking me
 perhaps something I should not answer, because I could
 not say. That would be for the brewers. It would not
 come under my notice.

3180. It would not be brought to your knowledge
 whether the sugar that was being introduced into your
 place was rather darker than usual?—No, it would not.

3181. Is there anybody from whom we could get that
 information?—Yes, the brewers.

3182. You have no reason to believe that of late Bos-
 tock's invert or glucose has been somewhat off colour as
 compared with their previous manufacture?—No. I
 have never heard the brewers say anything about it.
 I have never heard it complained of.

3183. If it were darker in colour does your knowledge
 enable you to say to what the darkness would be due?
 —No.

3184. The guarantees which you say you now get from
 the persons who supply you with brewing sugars are
 guarantees which you yourself have demanded, or have
 they been voluntarily supplied to you?—We have de-
 manded them.

3185. Garton Hill did not give you the guarantee
 until you asked for it?—I do not think so. I believe
 we asked for them, to the best of my recollection.

3186. Is the form of the guarantee satisfactory to you?
 —I think so. It states: "We certify that the saccharum

Mr. R. G. H.
 Tomlinson,
 25 Mar. 1901.

Colour of
 Bostock
 sugar.

Guarantees.

drying
 us to
 nie.

Mr. R. G. H. Tomson. to which enclosed invoice relates is perfectly free from arsenic or other deleterious ingredients."

36 Mar. 1901. 3187. Garton Hill's guarantee is a specific guarantee attached to every delivery?—Yes. The printed form I have read comes attached to every delivery.

3188. It is not a mere general guarantee covering all their supplies?—No; it comes with every invoice.

3189. Did the other persons who supplied you with materials give equally specific guarantees?—There is Dutton and Co., that is a porter sugar, and a very expensive one, too.

3190. With regard to that, which is stamped with the india rubber stamp; do you attach as much importance to that guarantee as you do to the other?—Yes, I should say so.

Caramel. 3191. Do you use caramel?—Yes.

3192. From whom do you get it?—I think it is Dutton's.

3193. Has that caramel been examined?—Yes.

3194. That caramel has been made from glucose?—I could not tell you what it is made from.

3195. You do not know the origin of it?—No, I do not.

Yeast of implicated brews had normal appearance. 3196. Has your attention been drawn to the occurrence of any exceptional colour in the yeast of late?—No.

3197. You yourself have seen nothing peculiar in the yeast?—No; I should have heard of it at once.

3198. No occurrence of any pink colour, or anything of that kind?—No.

3199. Nothing exceptional?—No, nothing exceptional.

3200. (Dr. Whitelegge.) Have you a form of certificate receivable with hops?—No, we have not.

3201. Do you require a certificate with hops?—No, we have never had any.

3202. Did you submit samples of hops to Dr. Miller?—I do not remember. I do not think we have ever had hops analysed.

3203. Then you did not send quite all the materials for analysis?—Apparently the hops we have not.*

(Dr. Miller.) I think you must have sent them at the beginning, but I have not had them lately.

(Witness.) I cannot answer that.

3204. (Dr. Whitelegge.) If any were sent the results were negative?—Yes.

3205. You told us the books you produce would show the source of the materials used in the manufacture of any particular beer?—Yes.

3206. So that afterwards you could trace any ingredient?—Yes.

3207. Would the returns you make to the Inland Revenue cover the same ground?—They would not be able to pick out the particular qualities of materials used, but they could pick out the quantity.

3208. They could not follow the ingredients of a particular brew?—You mean to say that, supposing we use Garton Hill's and Bostock's makes, they could not follow that?—No, they would not. How it was divided up they would not be able to tell. But, of course, we can trace it ourselves. Will you allow me to thank you on behalf of my directors for the courteous way you have treated me, and to say that we shall be very glad to give you further information if any is needed by the members of the Commission.

* Note by Witness.—The hops were analysed by Matthews and Lott and the local public analysts.

Dr. ALEXANDER K. MILLER, called; and Examined.

Dr. A. K. Miller.

3209. (Chairman.) You have been acting as consulting brewers' chemist for the large number of breweries in and around Manchester?—Yes.

3210. For many years past?—Yes.

Brewers' tests before epidemic not directed to arsenic or substances injurious to health.

3211. Before this period of November, when this epidemic took place, what was the system under which you tested beer or samples of beers from different brewers?—In the case of the samples they were all tested for their brewing value.

3212. And solely for trade purposes?—Yes.

3213. Then until November last you never tested any beer or material used for brewing except for the purposes of trade?—That is so.

3214. As to whether there was any substance in it that was injurious to trade, but without any consideration whatever as to whether there was any substance or material which would be injurious to human life?—That is so.

3215. It is only since this epidemic that you have examined beer or materials for the purpose of detecting whether they were infected with arsenic or not?—Yes.

3216. Will you tell the Commission under what standard you have been lately examining these various samples?—Recently the standard has been one set by the experts, Reinsch's test.

3217. By the Expert Committee?—Yes, appointed by the Manchester Brewers' Association.

3218. They framed this Committee when this disaster occurred?—Yes.

3219. It was formed for their protection in the future as well as to discover the causes of the catastrophe that had happened?—Yes, and the best way of eliminating arsenic.

Arsenic in non-Bostock beer.

3220. Have any of the beers you have tested since the disuse of Bostock's sugar failed to come up to the expert's standard of purity?—I should say that at the commencement, before the malts had been got anything like as pure as they are at the present time, there were occasionally beers which did not pass the test, but I think I should add that the test is undoubtedly far more delicate than is generally imagined.

3221. The test you are using to-day?—Yes.

3222. That being the test suggested by the Expert Committee?—Yes.

3223. (Dr. Whitelegge.) How delicate do you consider it to be?—I do not care to commit myself to any definite numbers, because I do not think any of the quantitative results which have come under my notice are absolutely reliable. I do not think there is any satisfactory quantitative method for determining accurately the minute quantities of arsenic which are present in these beers, so that I do not like to bind myself to any quantity. But I believe at the present time, if I may put it approximately, that the majority of the Manchester beers contain say 1-100th of a grain. I should say 1-50th of a grain is probably the maximum, and many of them contain nothing like 1-100th of a grain.

3224. The expert committee's test would not give a positive result for 1-50th?—I think it does.

3225. A positive result for 1-50th?—Yes.

3226. But not with a 1-100th?—The evidence I have in respect of that is this, that if I take a beer which gives absolutely nothing under the test, and if I then add to it 1-50th grain to the gallon the beer does not satisfactorily pass the test. Even when I add 1-100th of a grain to the same beer I get distinct indications of arsenic under the test.

3227. (Chairman.) You consider that a satisfactory test?—I consider it is much more severe than is generally imagined.

3228. (Dr. Whitelegge.) Does that suggest to you that the test improves with acquaintance, that skill plays a great part in it? That you would detect now by the same means a smaller quantity than you would have detected when you first used the test?—I dare say one does acquire a little extra skill. I have had about 4,000 samples passing through my hands, and it is possible one gets a little more skilled in it, but I do not think there is much in that.

3229. The previous witnesses have told us the test would distinguish 1-20th of a grain, and possibly more 1-30th?—It depends entirely on how the standards are made. For instance, if I add 1-20th of a grain to water and carry the test through in the usual way I may get indications of arsenic, but the test is undoubtedly far more sensitive in beer than it is in water.

3230. Can you say why?—No, I cannot. I am experimenting at the present time. I have tried the test time after time with water with 1-20th of a grain per gallon, and I get practically nothing. In beer, taking

Returns Brewer's Inland Revenue

Dr. A. K. Miller. Brewers' Expert Committee—delicacy

Reinsch more sensitive beer than water.

Dr. Miller. beer of the highest repute which gives nothing in the test, I can get indications of arsenic with 1-100th; with 1-50th, the beer does not necessarily pass the test, and the crystals are well marked.

3231. Do you attach importance to the size of the crystals in that connection?—The size in conjunction with the numbers undoubtedly.

3232. (Sir William Church.) In those cases in which you say the arsenic is indicated in beers when it would not be indicated in water, is it mere staining of the copper you go by?—No.

3233. Did you get arsenic crystals afterwards?—Yes. I say that the copper itself does not always become even discoloured with water.

3234. (Chairman.) I suppose it is very important, is it not, that there should be something like uniformity as regards the standard of tests applied?—That is so.

3235. It has come out lately, has it not, that samples of beer have passed a severe test, and then on a further test being applied the very same sample has shown traces of arsenic?—Any beer at the present time in this country would probably show traces of arsenic if the test is made severe enough.

3236. Do you think it is a question of degree, that there must be some arsenic in all the beers drunk, an infinitesimal quantity?—Yes.

3237. You have been testing these beers and substances ever since this catastrophe?—Yes.

3238. Can you state to the Commission what is your general idea as to the quality of the beer being drunk in Manchester or Salford at this moment. Should you say that although not absolutely pure from arsenic yet so far as any danger from poisoning was concerned it was sufficiently free?—Absolutely safe; and I should say the beer brewed in Manchester and Salford at the present time is as pure as any beer brewed in any brewing district in the country.

3239. Has arsenic been found especially in caramel?—No. I do not say it has not been found in any caramel, but taking caramels all round it has not been found in caramels more than in any other sugars.

3240. Have you been analysing malt for the purposes of discovering if any arsenic is contained in it?—Yes.

3241. Can you give the Commission the general result of your observations?—At the present time there is still some contaminated malt on the market, but the improvement as regards freedom from arsenic has been very marked. Many of the malts are practically free from arsenic, but there appears to be a difficulty even yet in producing absolute freedom; not universally, but in many cases. The malts, taking them all round, at the present time are practically free.

3242. As regards the test which you have been applying to find arsenic in malt, can you say at all over how large a district these samples spread? What I want to get at is: were these samples you have been testing given to you in Manchester, Salford, and the surrounding district, or from a larger district?—I have them from the brewers under numbers, so that I do not know where they come from. Then I have them from the maltsters throughout Yorkshire, Newark, Gainsborough and Nottingham.

3243. That is a considerable district?—Yes.

3244. Can you call to mind any district further south from which you have had specimens—Norfolk or Suffolk, Cambridgeshire, or the Southern Counties?—No, I cannot say I have.

3245. When you say that during the last 3 or 4 months, I presume you mean that period when there has been a great improvement in the quality of the malt?—Yes, during the last three months.

3246. Do you mean the Commission to infer from that that there has been rather an alarm spread owing to the information given as to the possibility of arsenic being in malt, and therefore malt has been looked more after and been much more cleansed?—It is not so much a question of cleaning and cleansing; that has not had anything like the effect that was hoped. It is chiefly the change in fuel that has brought about the improvement in the malt; in fact, it is almost entirely the change in fuel.

3247. Do you think the maltsters have discovered that danger may accrue from using a certain kind of coke?—Yes.

3248. And that that fact has prevented the use of that particular kind of fuel?—Yes.

3249. (Dr. Whitelegge.) What kind of fuel ought to be used?—Anthracite.

3250. (Chairman.) Are you of opinion that coke is dangerous for malting purposes, or only certain kinds of coke, and that some test should be applied to the coke?—I think some test should be applied to the coke. I do not think one can lay down anything definite as to one class of coke, such as oven coke, being absolutely safe, and gas coke being absolutely unsafe. I have had some samples of oven coke certainly worse contaminated with arsenic than some samples of gas coke I have had, and vice-versa. Speaking generally oven coke is probably safer.

3251. You think the only danger of the contamination of malt with arsenic arises from the fumes of the coke?—Yes. The anthracite is liable to be contaminated to a small extent, and some maltsters of repute tell me that some of the malts which I have returned as containing distinct traces have been dried solely with anthracite.

3252. (Sir William Church.) I want particularly to ask you a little about what you were in the habit of doing before there was any suspicion of anything being wrong in the beer. You have told us that you then used to have samples of brewing material sent you by the brewers for testing, to see that they were unadulterated?—Yes.

3253. Did you have the samples of finished beer sent you?—Yes.

3254. For what purpose did you examine them?—To determine the stability of the beer was one of the chief points.

3255. To see how it would keep?—Yes.

3256. How did you judge of that?—We put it on what is called a forcing tray, a flat vessel containing before water heated to 80° to 85° F. The samples of beer are placed in this warm place, and if they lack stability in a week or a fortnight's time one knows the beer will not keep. It will go sour.

3257. Even when you tested the finished beers you did not test them chemically to see whether there were preservatives put in?—No. The brewer, of course, would know what he added himself. There was no object in our testing them for what the brewer had himself added.

3258. Your testing of the finished beers at that time then was solely for the advantage of the brewer, to see how long they kept? You did not examine why they kept?—No, we tested the composition of the beer as regards the amount of maltose present in the beer and its stability, but no tests were made in any way to look for poisons.

3259. Your examination of the finished beers was never intended, or supposed to be in any way carried on, for the safeguarding of the public?—No.

3260. It was for the interest of the brewers entirely?—Yes.

3261. You told Sir William Hart-Dyke you thought the expert tests you were using now were much more delicate than was generally supposed?—I believe so.

3262. And you gave us very good reasons for thinking so?—Yes, and I have other reasons too.

3263. You said you took Burton beer?—Yes.

3264. Did you test that for arsenic before you added any arsenic?—Yes, I submitted it to the same test.

3265. And you found none?—I did not say I never found any, but in those particular samples, no.

3266. In those samples you added arsenic to, you found none?—I found none.

3267. And yet you said just afterwards you supposed there was no beer in England that would not show traces of arsenic?—There is a limit to the test. If the test had been made more severe. All I wished to do was to test the beer under the same conditions. If the test is made more severe I have no doubt you would find arsenic; in fact, I have found arsenic by the Reinsch test in the beer from the very same brewery. The samples vary.

3268. But not in the samples to which you added arsenic subsequently?—That was a sample which showed nothing under that particular test.

3269. You did not try to exclude arsenic altogether from that beer which you used?—I am afraid there is a difficulty about getting beer absolutely free, but it was free to the test.

Dr. A. K. Miller.
25 Mar. 1901.

Malting fuels compared.

Traces of arsenic in malt dried with anthracite.

Tests of beer before epidemic.

Application of Expert Committee's test.

Dr. A. K. Miller. 3270. You only used 200 cc. to begin with, I suppose?—Yes.

25 Mar. 1901. 3271. You did not use a larger bulk?—No.

3272. Or concentrate it in any way?—No.

3273. Therefore it is only an assumption of yours that all beers contain traces of arsenic?—Of course I have not tested every beer, but I think it is a fair assumption to make.

Arsenic in malt.

3274. How do you think the arsenic gets into the beers?—From the malts.

3275. You think that all malt is sufficiently contaminated to give traces of arsenic in the finished beer?—I think that in the future it will be possible to obtain beers distinctly freer from arsenic than any of the beer hitherto.

3276. I do not mean in the future, but you think that in the past the presence of arsenic could be demonstrated in all beers owing to the contamination of malt?—Yes. I believe in the case of large breweries where they may have arsenic-free malts that part of their malts have been contaminated more or less. Probably no large brewery will have worked entirely with arsenic-free malts.

3277. Did you ever have malts submitted to you in previous years for the purpose of analysis?—Yes.

3278. For what purposes?—For their brewing qualities. The amount of moisture present, the amount of extract which they yield, and their diastatic capacity, etc.

3279. You never examined them for contamination?—Not for poisons.

3280. I suppose that same remark would apply to other brewing materials, glucose and sugar, submitted to you?—Yes.

3281. You only examined them to see that they were pure from the brewers' point of view?—Certainly.

3282. You also told us that since your attention had been directed to the subject of arsenic in malt you had found many malts free from arsenic?—Yes.

Testing malt for arsenic.

3283. I suppose you infused the malt in some way, and then made use of the test?—I applied the Reinsch test directly to the malt itself without mashing it in any way.

3284. By boiling the malt?—I just ground the malt and submitted it to the Reinsch test.

3285. It is only lately you have done that; you never tested malt in that way previous to this epidemic?—No.

3286. Therefore you can say nothing as to whether any were free previous to this?—No.

3287. How do you think these malts have been prepared which you find now free from arsenic?—Chiefly with anthracite.

3288. I think you said that you knew some malts which were wholly prepared by anthracite fuel where there was arsenic?—Yes, the anthracite varies, but is not seriously contaminated like many coals.

3289. Among these malts you have examined lately, has there been a great difference in the amount of arsenic present in them?—A good deal of difference.

3290. Could you tell us at all where the worst samples come from?—Most of the samples I got merely from the brewers under numbers, so that I do not know where they come from.

Arsenic in fuels.

3291. You said you thought oven coke would probably contain less arsenic than gas coke. Have you ever made any analysis of coals for that purpose?—I have tested them qualitatively. I have not determined the exact amounts.

3292. Did you say qualitatively or quantitatively?—Qualitatively. Comparative tests on weighed quantities, so as to get a fair comparison.

3293. You have not, of course, had the time to do that lately?—No, I have not.

3294. Your opinion is that the probability would be that oven coke would be safer?—Yes.

3295. Could you give the Commission any information with regard to the origin of the fuel used for making coke in different parts of the country?—No, I cannot.

3296. I presume the Grimsby coke would very likely be oven coals, which are made in Newcastle and Durham?—I should think so.

3297. And Lincoln and Retford and Newark coke?—I have had contaminated coals from Newark.

D. A. K.

3298. Do you know sufficient of the malting trade to say what fuel is used in the Eastern Counties, Norfolk, and Suffolk and Cambridgeshire?—No, I cannot say, but I think a good deal of coke is used throughout.

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3299. Yes, but we do not know where the gas coke used would come from, whether the London gas works or where?—No.

3300. Have you ever found contamination by arsenic in any of the other substances used in brewing, except in the glucose and sugar and malt?—You will find traces in the other substances.

3301. In what substances?—In some of the hops.

in hops

3302. In any others?—The malts and the sugar and the hops and the antiseptics are liable to contain traces.

3303. Which ones are those which are most apt?—The sulphites and the bi-sulphites. Of course the quantities used are very small.

in sulph

3304. You do not think they have ever contained sufficient to be a source of danger?—No, I think not.

3305. Nor in any of the materials which I believe are sometimes used for clearing beer?—No, nothing more than minute traces.

3306. Different preparations of calcium are used largely?—Yes, bi-sulphites.

3307. (Professor Thorpe.) Do you wish us to believe that what is known as the experts' test is a sufficiently stringent test in the interest of public health?—I think so.

Limits Expert Commi test.

3308. Even although it is proved that the experts' test does allow a certain quantity of arsenic to slip through?—Yes, I think so.

3309. Would you recommend that that test should be laid down if necessary as a statutory test to be applied to beer?—I think the test might be modified.

3310. Modified in what direction?—I think that 100 cc. of beer with the boiling carried on for one hour instead of three-quarters the test would be improved slightly. It would be amply delicate enough.*

3311. Of course by halving the amount of beer you halve the amount of arsenic which is present?—Yes.

3312. You increase the duration of the boiling by 15 minutes?—Yes.

3313. You would not get under these circumstances a very much larger deposit of arsenic so as to make the certainty of catching it very much greater?—I think the certainty would be increased.

3314. When the amount you start with is only half?—I think that by carrying the boiling on for a further quarter of an hour—

3315. That is a very small percentage increase. I do not know that the addition of 15 minutes would make such a great difference in the amount of arsenic deposited on the copper?—What I wished to imply was that I thought the test before it is fixed as a standard should be submitted to further defined tests, and that was merely the direction in which I thought it might be done, but I did not wish to lay down any definite opinion on that point.

3316-7. Your opinion, so far as it goes, is rather in the direction of relaxing the test than increasing the stringency?—I may tell you that I think the test is a bit severe. It has been severe as a provisional test, and I think very severe, considering the circumstances. I do not think it can be too severe in the future in the least.

3318. I mean having regard to the possibility of a definite statutory test, or a test which has the legal value of a statutory test, being laid down?—In that case I should think the test does not want to be diminished in stringency.

3319. Have you formed any idea in your own mind why it is that it is easier to detect minimal quantities of arsenic in beer than in water?—No; it is only compara-

Reinsch more sensitiv beer th water.

* Note by Witness.—In giving this answer I had in my mind some early experiments in which 200 c.c. beer was boiled down to 100 c.c., and the Reinsch test then applied to the latter. The quantity of beer tested was therefore, 200 c.c., and not 100 c.c., and the test in this form is extremely sensitive.—A.K.M.

Dr. Miller. tively recently that I have satisfied myself it is so. I cannot say why.

3320. Are you aware that Professor Delépine is of the same opinion?—No.

3321. It is entirely an independent opinion?—I have not heard a word from Professor Delépine on the subject. I have known it for some little time. I was experimenting only yesterday, because I wanted to state it more positively than I was in a position to do before.

3322. Have you any reason to think that it may be the small quantity of alcohol which may be present which has an effect?—I do not think so, because the alcohol was boiled off in some of the experiments with beer before the copper was added and the Reinsch was still very sensitive.

3323. I suppose it is some influence which keeps the surface of the copper clean which allows the deposition of the arsenic upon it?—The copper comes out quite clean from the water experiments.

3324. There must be some influence of the solution on the copper to bring about the change?—Yes, unless the organic matter has some reducing action; but I do not know.

3325. Have you had occasion to test caramels?—Yes.

3326. Any number?—A good many.

3327. How are caramels usually made—from what material originally?—One, I believe, that I know of is made from glucose, but I think a good deal of them are made from cane-sugar. I do not know much about it. The process is kept secret.

3328. Have you any reason to believe that glucose which is off colour is sometimes used in the manufacture of caramel?—No.

3329. Do Bostock's make caramel or have they made it?—I do not think so. I came across one caramel which was seriously contaminated, but I was not able to trace it, so I have not said anything about it.

3330. Where did you come across that?—It came from a Liverpool firm. I asked for a further sample so that I might confirm it absolutely.

3331. A Liverpool seller or a Liverpool brewer?—A Liverpool seller.

3332. A manufacturer?—I got it from a brewer.

3333. Was the person from whom the brewer got it a manufacturer or an agent?—I believe he was an agent. They told me it was of German manufacture.

3334. The caramel was a German manufacture?—Yes, this particular sample.

3335. Was this very largely contaminated?—Yes, very largely contaminated.

3336. More so than Bostock's invert?—I should think to about the same extent. At any rate it was very seriously contaminated.

3337. Have you examined a good number of these glucose and inverts?—Yes.

3338. Other than Bostock's?—Yes.

3339. Have you found any to contain arsenic?—No.

3340. Only Bostock's?—Yes.

3341. Have you examined any foreign glucose?—Yes, one which contained distinct traces, but nothing like Bostock's.

3342. Bostock's invert and Bostock's glucose are the only brewing sugars in which you have found any sensible quantities of arsenic?—Yes.

3343. You told us that in your opinion the improvement, as regards freedom from contamination with arsenic, in malt was largely due to the substitution of anthracite for coke?—Yes.

3344. Could you go so far as to say it must be obligatory on the maltster to use anthracite?—It is difficult to say, because one maltster tells me that he can get arsenic free malts with the use of coke. I should not like to say it should be compulsory until the matter has been further investigated.

3345. You indicated a preference for the use of oven coke of the two cokes?—I think so. Generally speaking, it is preferable, but some of them are badly contaminated.

3346. What are oven cokes mainly used for?—I do not know, beyond maltings.

3347. Are they used by iron masters?—I do not know.

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3348. Is there any particular kind of coal used for coking in an oven?—I do not know. I have never known much about these cokes; that which I know is entirely of recent acquisition.

3349. You are not aware, for example, whether persons coking coal in an oven would prefer to have their coal more free from sulphur than the gas manufacturer, for example?—I do not know.

3350. You spoke of testing malt. You gave Sir William Church to understand that you did that by what is practically the expert test?—Yes.

3351. You made an infusion of malt?—No. I made no infusion. I put it through the mill to grind it and boiled it with water, acid, and copper.

3352. Boil the whole thing together?—Yes. I tried mashing it, but I did not get such good results; if the malt is mashed first the test is nothing like as severe, and the brewers have asked me to test their materials as severely as possible.

3353. Would you be using an amount of material more than equivalent to the 200 cc. of beer?—Yes.

3354. In the case of the malts your test would be more stringent than in the case of the beer?—Yes, considerably more.

3355. I suppose you are frequently in breweries in Manchester?—Yes.

3356. Has your attention been drawn to any peculiarity in the yeasts of late years in the breweries?—No.

3357. Have you had the opportunity of looking for selenium in any of the materials that have come under your notice?—No. I cannot say I have.

3358. Have you tested for selenium?—No. I have only tested one or two beers the brewers have sent me to be tested.

3359. What happened in the case of the beers?—I could not find any.

3360. Whose beers were sent to you?—This was a brewer in Blackburn. He simply sent the beer because he had heard that there was an attempt at a "selenium scare," and he was somewhat alarmed, and asked me to test the beer.

3361. Had he been using Bostock's material?—This was only comparatively recently—a long time after Bostock's materials had been off the market.

3362. Have you examined any sulphuric acid which has been used in the manufacture of these inverts or glucose?—No.

3363. Have you considered at all in what form the arsenic is in beer?—No. I have thought about it, but I did not see how to arrive at a conclusion at all.

3364. You have no supposition in your own mind as to the form in which the arsenic exists in beer, whether as arsenious acid or the combination of arsenic as some organic compound?—No. I do not see why there should be any organic compound. Arsenic is probably present as arsenious acid in the malt, and I should think it would go in the same form into the beer.

3365. In what form is it in the invert or glucose, arsenious acid?—I think so.

3366. Does anything occur to you whereby in the process of fermentation any arsenical compound could be produced?—No.

3367. Anything in the nature of cacodylic acid or anything of that kind?—I do not know.

3368. Have you examined any yeasts for arsenic?—Plenty.

3369. Have you found it?—Yes. Yeast has a remarkable power of accumulating arsenic in it.

3370. Do you mean there is some specific action on the part of the yeast organism to take out arsenic?—Yes.

3371. You think arsenic is practically a sort of food for the yeast?—Or else the arsenic gets in and cannot get out again.

3372. Is it anything connected with the metabolism of yeast, or is it a mere mechanical action?—I cannot say, but I know that the yeast contains far more than the beer.

3373. Does it occur sporadically; is there any relation between the amount of arsenic in the yeast and the amount of arsenic in the original materials?—I cannot say that there is.

3374. Do you sometimes find much arsenic, and some-

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Test for arsenic in malt.

Selenium not looked for.

Question of combination of arsenic with organic matter of beer.

Affinity of yeast for arsenic.

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times little arsenic on the yeasts?—No. Before the malts were really pure, as they are now comparatively speaking, the yeasts were badly contaminated. Now the yeasts are only slightly contaminated. In some cases they come out quite pure under the same tests.

3375. Have such samples of hops as have been submitted to you contained much sulphur?—I have not tested for sulphur, but only for arsenic.

3376. It is not conceivable in your mind that the arsenic on the yeast may have been mechanically thrown down by the action of sulphuretted hops upon a solution of arsenious acid?—It never occurred to me.

3377. Is that a likely surmise, do you think?—I should not think it was impossible.

3378. Supposing you were to boil hops dusted over with sulphur, or containing sulphur, with a solution of arsenious acid, as you would, of course, might not that lead to the greater precipitation of arsenious sulphide?—I should think it would.

3379. And the yeast would tend to pick it up or mechanically entangle it?—Yes.

3380. (Dr. Whitelegge.) You were going to give us some additional reasons for considering the expert committee's test a very delicate one?—Yes. I know for a fact that certain beers which I have tested have been tested also by the Marsh test by a chemist of repute, not in one case but in three or four cases. Where I have told the brewer that his beer was near the limit permitted by the test, but not outside it, the quantity of arsenic present has been reported to him by the other analyst in one case as 1-200th of a grain, and in another 1-300th of a grain. That was done by a chemist of repute, who is certainly able to carry out the Marsh test in a satisfactory form.

3381. What is the largest amount of arsenic you have found in malt?—I have not made any exact quantitative experiments. I should think up to 1-20th or 1-30th of a grain, certainly, to the pound.

3382. Have you condemned malts for arsenic found in them?—Yes.

3383. Do you condemn them if you find any arsenic at all?—No. I leave it to the brewer to use his own discretion when the trace is small.

3384. You report the amount to him?—I carry out the test in a severer form than in the case of the beers; then if I get distinct crystals which I should not pass in the case of the beer I advise the brewer to get a purer malt, because a malt giving a sublimate which in the case of the beer would not be regarded as satisfactory, cannot be considered satisfactory. It is merely a comparison. I have the expert's test as a guide, and I make the test severer in the case of the malts, because the brewers have asked for it.

3385. You mean you make it more severe having regard to the amount of malt that goes into beer?—Yes.

3386. You take an amount of malt which is comparable to the 200 cc. of beer?—Yes. I take an excess of the malt over that.

3387. In those which you condemn you say there is arsenic present?—Yes.

3388. And they ought not to be used?—Yes.

3389. The last witness told us he was not in the habit of sending samples of the hops for analysis, but I gather from you other brewers do?—Yes, some.

3390. Have you had occasion to condemn any hops containing arsenic?—No, but I have advised the brewer when arsenic is present to give his hop merchant a caution, because there is no doubt that hops can be obtained easily free from arsenic.

3391. Perfectly free?—I should say so.

3392. Can you tell us how much arsenic you found in the sample of glucose said to be German?—No; it was only a trace.

3393. Can you tell us the amount in the caramel sample?—No. I only had the one small sample I have already spoken of, and I condemned it at once. I wrote for further samples, but it was too late. They had returned it all.

3394. (Sir William Church.) I should like to know what you mean by the term in your certificate "pure" with regard to malt?—I mean that under this test I can find no arsenic in it.

3395. (Chairman.) In each case?—Yes.

3396. (Sir William Church.) Under the experts' test?—Yes. It is a modification of the experts' test.

3397. (Chairman.) You use a distinct expression with regard to the malt to what you use with regard to the finished article. You say with regard to beer "It readily passes the expert test." What Sir William Church wishes to know is why you use the term "readily passes the expert test" as regards the beer, and a different term with regard to malt. You say "M56 is pure"?—The experts merely laid down the test as regards the beers. They have given me no instructions whatever as regards materials. That is left to my judgment, and at the request of the brewers I have applied a severer test to the materials, and if I get no arsenic under that test I report them as pure.

3398. (Sir William Church.) "Pure" means absolute freedom from arsenic, not that there is a trace of arsenic in it?—It means there is absolute freedom as indicated by that test. That this test applied in a severe way to the material shows nothing.

3399. (Professor Thorpe.) In fact you mean, if I am able to read your mind accurately, that inasmuch as in the case of the malts you have condemned a proportionally larger quantity of potential beer you think it has been therefore more stringently applied?—Yes.

3400. (Sir William Church.) But "pure" means that it did not react to that test?—Yes.

3401. (Chairman.) Are you aware that any beers which have passed your test have been pronounced arsenical by a public analyst or any other chemist?—Yes. I may say that in the case of one brewery where they have never had Bostock's sugar at all, in a certain town not far from Manchester, they got a threatening letter from the authorities saying their beer contained 1-250 of a grain per gallon; that they were not going to prosecute on that occasion, but that it was not to occur again. There is another case of a brewery whose beers are at the present time really practically pure. They will not touch any malts which I have not passed as pure, and their beer certainly contained nothing like 1-100th of a grain. In their case they have a prosecution coming on, I believe. The public analyst reported the beer contained a trace too small for him to estimate. On the strength of that certificate I believe the authorities are going to prosecute, but in my opinion the beer is absolutely safe.

3402. (Sir William Church.) Have you any idea of the amount of arsenic that can safely be present?—No, I think it is a question for the medical men.

3403. But you just now expressed an opinion. You said you were quite sure you passed no beers that were not absolutely safe?—I do not think I said that. I said, in the case of this particular brewery, where I know their malts have been all tested by myself and found to be free, I am perfectly satisfied that in that particular case the beer must be absolutely safe, because their materials have all passed through my hands, and I know the degree of purity, and at the present time they cannot obtain purer malts than they have been obtaining.

3404. That only comes to this, that you would not be prepared to express an opinion to the Commission whether any beer is safe?—Whether any beer is absolutely free; I should not like to say that.

3405. You have not formed any opinion as to what amount is harmless?—Certainly not.

3406. (Chairman.) But you have spent many months in going into these matters very thoroughly and testing, not only beer, but all materials used in beer. You have studied the marked change there is as regards purity of material, especially as regards malt, and you are satisfied that with a little common care beer brewed from malts and hops can be absolutely secure as regards the consumer?—Certainly.

3407. (Dr. Whitelegge.) Have you examined any beers for arsenic of a date prior to the trouble with Bostock?—Yes, you mean recently?

3408. Yes. With what results?—Two or three weeks ago I had a batch of beers sent to me from one of the local breweries. They generally send me all their brews—about a dozen at a time. I received about a dozen, and these came out so different from usual that I did not know what to make of them, and I sent a report saying that none of the beers passed the test. I expected to hear from them next day, but as I heard nothing, I went and saw the brewer, and asked "What

Dr.
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Beer pass
Expert C
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lyst.

Arsenic in
malt.

in hops,

in caramel.

Arsenic in
non-Bost
beer before
epidemic.

Dr. Miller. are you doing?" He took me into the office and showed me the actual bottles from which the samples were taken, and told me the explanation was this. These were beers which were purchased from different public-houses last November; I was shown the list of the breweries supplying them, and some of these were certainly breweries where no Bostock sugar had been used. In spite of that, not a single beer passed the test as I am now applying it.

3409. Can you give us an idea of the quantity of arsenic?—I should not like to say. They were tested by the same test. It satisfied me and satisfied them that even the contamination of the malt at that time was very different from what it is now.

3410. Were they local brewers?—Yes.

Mr. HAROLD B. DIXON, called; and Examined.

Mr. Dixon. 3414. (Chairman.) You are Professor of Chemistry at Owens College, and a Fellow of the Royal Society?—Yes.

3415. Can you give the Commission some information as to the presence of arsenic in sulphuric acid?—Yes. Whenever the sulphuric acid is made from pyrites—and, indeed, when it is made from brimstone, it may contain a little—but when made from pyrites it generally contains a good deal, especially nowadays, when it is made most largely from Spanish pyrites.

Spanish 3416. A large percentage of pyrites comes from two es, sources, but is chiefly Spanish?—The most important ones are from Spain, the Rio Tinto and the Tharsis mines. The next largest quantity is from Portugal, an extension of the same mines, and practically the same material.

3417. In the case of sulphuric acid that is used in connection with beer or food, do not you think some very safe process should be gone through to eliminate the arsenic?—Obviously.

3418. I think the Commission would like you to describe the means by which this can be done. Or perhaps it would be better for you to go into the manufacture of sulphuric acid, and then deal with the purification afterwards?—The pyrites are chiefly used on account of their cheapness. They contain 3 per cent., or a little more, of copper, and the sulphuric acid manufacturers really purify the pyrites so that they can be used for the extraction of copper afterwards. It is for this reason that these particular pyrites have superseded other sources of sulphur. The pyrites are broken up and burnt in kilns, and the sulphur from the sulphide of iron burns off as sulphurous oxide and passes through flues, generally through what is called a Glover tower, and then into large leaden chambers where the chamber acid is made. If there is arsenic in it, and there is always some arsenic in the Spanish pyrites, the arsenic mainly burns off as arsenious acid, and this is partly caught in the flues and partly in the Glover tower, down which a strong acid is falling, so that the gases are washed on their way to the chamber. In the washing and in the previous cooling and dust chambers most of the arsenic gets caught. The remainder passes on into the chambers where chamber acid is made. Therefore, in considering sulphuric acids we have to distinguish sharply between Tower acid, the acid which falls down the Glover tower, and contains a considerable quantity of arsenic, and the chamber acid, which is made further on, which contains always less arsenic. The chamber acid which is made in the large leaden chambers is generally evaporated down to make it stronger, and where the Spanish pyrites are used they are largely purified from arsenic by several processes. You will probably get more exact information from manufacturers, but it is not very easy to get evidence on this point; I know in this district that hydrogen sulphide is largely used as a means of purification. The contact of hydrogen sulphide with the arseniated acid produces sulphide of arsenic, and this forms gradually a yellow precipitate which settles largely, and the rest is filtered off. The purified acid is then boiled down until we get either the ordinary acid, called B.O.V., when it is evaporated down in leaden pans to a density of 1.7, or rectified acid when it is boiled down more thoroughly in glass or platinum vessels.

3419. Do you know if it is the practice at these works where sulphuric acid is made to test each lot of acid as it is made for the presence of arsenic?—I do not know.

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3411. All of them?—I believe so.

Dr. 3412. (Professor Thorpe.) Do you mean us to believe A. K. Miller, that seriously arsenicated beer was in use prior to the trouble of which we have heard?—These were all taken 25 Mar. 1901. in November.

3413. When were they brewed?—Probably they were brewed within a few weeks of that time. What I mean is that in some cases they would be from breweries where no Bostock's sugar had been used. Of course, I reported some of those which were worse contaminated than others. I should have had no difficulty if I had been asked which were Bostock's and which not in discriminating between the two. But even those not brewed with Bostock's sugar would not pass the test as it is now being carried out, and this is further evidence that the test is not a light one.

3420. Do you happen to know what tests are applied in these works?—I know where they are purifying from arsenic they apply hydrogen sulphide afterwards to see if the arsenic has been precipitated.

3421. If you get sulphuric acid in your laboratory, do you find arsenic in it?—Nearly always.

3422. If you get what is called the finest sulphuric acid?—It is rather a chance whether it contains a trace or not. It is very difficult to get it quite pure. Even when you buy it as quite pure, it sometimes contains a trace. Difficult to get sulphuric acid quite free from arsenic.

3423. (Professor Thorpe.) You have had some of this Nicholson's acid through your hands, have you not?—Yes.

3424. How did you become possessed of it?—Dr. Tattersall brought it to me.

3425. From where?—I believe from Bostock's.

3426. What type of acid was it?—I should imagine it was tower acid.

3427. What was the colour of it?—It was a dark brown, with a precipitate in it.

3428. What was the colour of the precipitate?—Brownish.

3429. Did you recognise it as brown oil of vitriol?—I should have considered it a tower acid. Brown oil of vitriol is rather a common name given now to that which is brown as well as to that which is not brown. You will find the name B.O.V. is given to an acid which has not any brown colour at all. The name is a survival.

3430. Does not brown oil of vitriol denote acid of a particular strength?—Yes, from about 1.7 to 1.73.

3431. Was this acid of that type?—Yes.

3432. It was not rectified oil of vitriol, or so-called double oil of vitriol?—No.

3433. Did you analyse that acid for arsenic?—Yes.

3434. What amount did you find?—1.44 per cent. by weight of arsenious acid. Amount of arsenic there.

3435. How did you determine that amount?—I weighed in it as sulphide of arsenic.

3436. How did you get it out?—I used Hatten-sauer's method. I diluted the acid to about 1.55 with pure water, and then added an equal volume of pure hydrochloric acid. I then precipitated it by passing hydrogen sulphide through it for about five hours, testing the acid when it was clear to see if any more fell. Then the arsenic sulphide was collected and dried, then weighed, and then tested to see whether it was completely volatile and soluble in ammonia. It was both. I then heated it in a tube in a current of carbonic acid, and the residue was weighed again. I took the residue to be As_2S_3 .

3437. Did you examine the precipitate when you got it out of the acid?—It went into solution mainly when I added the water. There was very little to filter. I did filter it, but it was very little.

3438. What do you think it was?—I imagine some arsenious acid was there, and a little suspended oxide of iron.

3439. Was the sulphuric acid practically a saturated solution of arsenious oxide?—I should think very nearly.

3440. Have any determinations been made as to the amount of arsenious oxide which sulphuric acid would

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take up?—Not very accurate ones. It depends upon the strength of the acid. I do not know of any accurate determinations.

3441. Do you know of any other determinations which have been made of the amount of arsenic in Nicholson's acids by different people?—Only by hearsay and newspaper reports.

3442. Is it known as to whether considerable quantities of this saturated solution of arsenious oxide have been delivered by Nicholson's to Bostock's?—I have heard that Professor Campbell Brown, of Liverpool, tested this acid from Bostock's, and found, I think, nearly 2 per cent. of arsenious acid in the sulphuric acid. I have heard of another analysis going as high as 1·8.

3443. In those cases was there also a sediment?—I believe so, and I believe the sediment was reckoned as well.

3444. Did that sediment contain arsenious oxide?—I believe so; but I dissolved my sediment before precipitating.

Selenium.

3445. Have you examined that sulphuric acid for selenium?—I did not examine Bostock's acid for selenium, but I have examined another acid made in practically the same way from Rio Tinto ore for selenium, and I have examined the flue dust in a large works where Rio Tinto ore has been used.

3446. Was there much selenium?—None that I could detect.

3447. Was there any in the dust?—No, nothing appreciable.

3448. You know that to be the same source of ore as Nicholson's?—No; I think Nicholson is using Tharsis, but it is very similar. One ought to detect it if present in the flue dust. It is quite easy to detect selenium in flue dust when seleniferous ore has been used.

3449. When selenium dissolves in oil of vitriol, does it give it any particular colour?—Yes; it goes green.

3450. Therefore, when it is present it attracts attention at once?—Generally.

Proportion of
arsenic in
Nicholson's
acid extremely
high.

3451. (Dr. Whitelegge.) Does not tower acid contain a great deal more arsenic than chamber acid?—Yes, usually.

3452. In the example you give in the *précis* the tower acid contained '735 per cent., and the chamber acid '139?—Yes.

3453. In the sample of Bostock's you told us you found 1·44. May we take it that that is an excessive amount of arsenic to find in sulphuric acid?—I think it is. I have not found so much myself anywhere else.

3454. Can you tell us what would be an ordinary amount to find?—I think anything up to 1 per cent.

3455. (Professor Thorpe.) How do you surmise so large a quantity of arsenious oxide could have got into this acid? What condition of manufacture could have led to so large a quantity being there?—I can only imagine that the flues contained a large quantity, or the dust chamber. I have not been over Nicholson's works, and do not know whether they have a flue or not, but probably they have some form of dust chamber, and perhaps some of this material was carried over into the tower. I imagine this acid must have been tower acid.

3456. Obviously it must have been going on for some weeks or even months, apparently, the saturation of this sulphuric acid with arsenic?—Yes.

3457. What condition of manufacture occurs to you which would induce it?—The flue dust very often contains 40 to 50 per cent. of arsenious acid, and if a considerable quantity of this got carried over and fixed in the Glover tower the acid running down the tower would be nearly saturated, because it comes out hot, and hot acid dissolves more arsenic than cold acid.

3458. Does a vitriol maker ever clean out his flues?—Yes.

3459. Do you imagine it was neglect on the part of Nicholson's to clean out their flues which led to this?—I cannot say.

3460. (Chairman.) Have you any other suggestion to give as to the presence of that abnormal quantity?—No. I have found arsenic to vary rather considerably. This 1·44 happens to be the largest I have personally found in sulphuric acid, although I have not examined any large number.

3461. (Professor Thorpe.) Is Tharsis ore or Rio Tinto ore known to contain a large quantity of double sul-

phide and arsenide of iron. Does the arsenic run up and down?—Different parts of the ore contain different quantities. There are pockets of this ore in which sometimes the copper is very much richer than in other parts, and I think the same thing applies with regard to arsenic. I know you must take a very considerable quantity of the ore to get an average sample, and therefore any particular sample used in the kilns may contain more arsenic than at another time. Some of it, I believe, is free and some contains a considerable quantity. It is usual in making an analysis to sample some three months' working, 2,000 or 3,000 tons at a time.

3462. When an analysis is made of the ore, to what extent is the analysis carried?—When the sulphuric acid makers buy it they only determine the sulphur, I believe, because that is the only thing they are going to make use of it for.

3463. Do they take no notice of the other things?—No; they do not even determine the copper. They guarantee that the copper goes back.

3464. The sellers of the ore take back the spent oxide?—Yes.

3465. (Chairman.) Arsenic is not spread over the whole material as an average, but if there is a large amount of material taken, a large quantity may be found in a small portion of it?—I believe that is so. I have not any direct experience of that, but looking at the analyses published of Rio Tinto ore one can see that some of the analyses were as high as 2 per cent. of arsenic, and yet the average is perhaps only '5. The sample I examined lately was from 2,000 tons of ore worked for three months, April, May, and June, last year. I had a sample of which the sulphur had been determined, and I determined the arsenic, and I found '53 per cent. of metallic arsenic, a larger percentage in that than was the average in 1886, viz., '33 per cent.

3466. (Professor Thorpe.) Selenium is generally met with in the Norwegian product, is it not?—Yes, and the Norwegian Hartz pyrites, but in the Norwegian most. I have samples of dust from Norwegian works containing plenty of selenium.

3467. Is Norwegian pyrites used much in this country?—It has been all superseded, I believe. I do not think any is imported.

3468. (Sir William Church.) With regard to the flue dust, supposing that the flues and the dust chambers are insufficiently attended to, would that cause the Glover tower to be a source of arsenic rather than a means of straining it off from the acid?—Yes, that might be so.

3469. And do you think that might occur and might not improbably be the source?—It is always liable to occur, I think.

3470. I suppose in the same way, not sufficiently changing the materials in the Glover tower would lead to a highly impregnated sulphuric acid?—I do not think they are often cleaned out.

3471. (Dr. Whitelegge.) Do you think if sulphuric acid is intended for use for food purposes it is safe first to trust to the manufacture of arsenical acid and then to its purification?—I think it wants careful testing. I think an acid can be purified, and you can get an acid as free from arsenic as you can get the acid from Sicilian sulphur. Sicilian sulphur does sometimes contain a little arsenic.

3472. But you think if it is made from an arsenical Constantan pyrites it is necessary to exercise constant care and care supervision?—Certainly. It is, I think, easy to allow some arsenic to go forward when one of these methods of purification is used. I think it wants constant care.

3473. And such an accident must occur now and then if there is not sufficient care?—It is always liable to occur.

3474. Can you tell me how much arsenic you find in what is sold as the finest form? You told us that sometimes you found very little and sometimes a great deal?—In that which is sold as the purest brimstone acid sometimes one finds none at all and sometimes one finds a trace. It is not in a weighable quantity. In order to determine the amount one would have to make a comparative experiment.

3475. (Sir William Church.) Do you think that what is called brimstone acid could be used without being brimstone actually tested to see whether it is free from arsenic?—It depends rather on the sulphur that is used, because the name brimstone is given not only to the nearly pure

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1901. Sicilian sulphur, but also to recovered sulphur obtained from calcium sulphide, the alkali makers' waste, which often has a great deal of arsenic in it, and unless the method by which the sulphur is recovered is a good one and carefully watched you may have arsenic.

3476. Do you think if it is made compulsory that sulphuric acid used in the preparation of food products should be made from sulphur, that would be reckoned enough without examining to see whether it was free from arsenic?—I do not think it would, because I think a sulphur might be got which contains a lot of arsenic. Some Japanese sulphurs contain a good deal. It happens that Sicilian sulphur contains very little, but it does contain some here and there. If you merely say sulphur, there are sulphur mines in many parts of the world, and there would be no security either that the natural sulphur, or the sulphur re-

covered from some manufacturing process, was free from arsenic.

3477. It would not be a sufficient safeguard then?—Not nearly. The purest sulphur I know of is that got from coal gas works, the spent oxide sulphur. That contains none.

3478. (Chairman.) You have never discovered any in that?—No, and that is used in this district for making brimstone acid.

3479. (Dr. Whitelegge.) Can you tell us of any organic compound of arsenic that would tend to throw light on the recent difficulty?—I am not a professor of organic chemistry and could not answer that question. It is possible, but I do not think it is likely.

3480. (Chairman.) I think you have brought us some specimens of flue dust and other materials to show us?—Yes. (Specimens shown to Commission.)

Dr. T. N. KELYNACK, called; and Examined

3481. (Chairman.) You are Hon. Medical Officer to the Pendleton Branch of the Salford Royal Hospital?—I am.

3482. And Medical Registrar to the Manchester Royal Infirmary?—Yes.

3483. Assistant to the Professor of Medicine at Owens College, and Lecturer on Food and Food Inspection at the Manchester Technical School?—Yes.

3484. You have some important evidence to give us with regard to the history of the epidemic of arsenical poisoning, which you have been personally investigating?—Yes. On returning from my summer holidays in September, 1900, I noticed that a large number of alcoholic cases were attending my out-patient department at Pendleton. During the autumn these increased in number, and many presented exceptional features. At the beginning of November Dr. J. W. Crawshaw, of Weaste, called on me, and described what was thought to be an anomalous case of Addison's disease then under his care. On the 12th I saw the patient with him. The symptoms were those of chronic arsenical poisoning. During November a marked increase in the number of cases of peripheral neuritis in the Manchester Royal Infirmary was noticed, and the cause discussed. On attention being directed to arsenic as the probable explanation, I arranged on November 20th with my colleague, Mr. Kirkby, Lecturer on Pharmacognosy, in The Owens College, and Dr. Forsyth and Dr. Harold Bailey for an investigation of the matter. Mr. J. G. Groves, M.P., of the brewing firm of Messrs. Groves and Whitnall, afforded us every facility for our work through Dr. Forsyth, medical officer to the workmen engaged in the brewery. The presence of arsenic in the beer was at once detected, and the source speedily traced. On Friday morning, November 23rd, as Mr. Groves has already told the Commission, I called at the Salford Brewery, and informed him that Mr. Kirkby had discovered the presence of arsenic in the invert sugar, and its further use was, I believe, immediately stopped. I also communicated with the Medical Officers of Health for Manchester and Salford, and Professor Julius Dreschfeld, Senior Physician to the Manchester Royal Infirmary was also informed. Our investigation throughout was designed and conducted purely on scientific lines and solely in the interests of the public health. During the latter part of November, and the beginning of December, through the courtesy of the Medical Officers of Health for Heywood, Bacup, and Blackburn, I was enabled to examine patients in those towns, and compare them with our Manchester and Salford cases. I also saw many sufferers in the Workhouse hospitals at Liverpool and Withington, and a number with private practitioners. Being urged to publish our results, Mr. Kirkby and I issued early in the present year our book on "Arsenical Poisoning in Beer Drinkers," which forms the basis of my evidence. A study of the outbreak shows that it is possible to make a rough division into more or less definite stages: (a) The onset, when the symptoms were chiefly those of irritation of skin and mucous membranes; (b) second stage, when more or less distinct multiple neuritis was present; (c) the stage of decline. The invasion of different districts has not been simultaneous. The gradation in the development of the outbreak helps to explain the delay in the recognition of the true cause of the epidemic. In the

early stages the condition was confused with such affections as influenza, gastro-enteritis, conjunctivitis, Addison's disease, and various skin lesions. When neuritic symptoms became marked they were not unnaturally first thought to be dependent solely on the alcohol. There have been considerable local variations in the time of onset, severity, and duration. In Heywood, at the end of November, I saw cases which dated their first symptoms as far back as Easter, 1900. Dr. Hitchon, the M.O.H., informed me that the cases occurred in epidemic form immediately after the Whitsuntide holidays. In one rural district in which I saw cases, and where the beer contained as much arsenic as 1.4 gr. per gallon, the brewer early recognised the pernicious character of his brew, and on November 7th had it submitted to an analysis, and ultimately arsenic was found in it on November 17th. Although anomalous cases of peripheral neuritis and muco-cutaneous affection were occurring in Manchester and Salford in the spring of 1900 the outbreak, as judged from our hospital experience, did not assume serious proportions until October. A large number of cases dated their symptoms back to September. This is in part explained, I think, by the fact already indicated by Mr. Groves in his evidence, that, as regards his brewery, which supplies a large number of houses in Manchester and district, the arsenicated sugars were not used until August. During the three months, November, 1900—January, 1901, 41 well-marked cases were under observation in the Manchester Royal Infirmary. These I have tabu-

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CASES of Arsenical Neuritis under Treatment in the Manchester Royal Infirmary during Nov., Dec. 1900, and Jan. 1901.

	Under 30.	30.	40.	50.	60.	All ages.	Average age.
Males	—	7	12	4	1	24	43
Females	1	7	11	—	—	19	39
Total	1	14	23	4	1	43	41

The poor have suffered most severely. Both men and women have been affected. Some of the severest cases, and the majority of the fatal cases, have occurred in women. The average age of our recent infirmary cases has been 41 years, the average age of the women being 39. I am convinced that the published statistics give a very inadequate expression of the facts. Not unnaturally a great reticence has been apparent amongst many of the affected cases, and this reluctance to seek advice I have observed amongst the very poor. Considering the immense number of drinkers of beer known to have been arsenical it is surprising that more did not suffer. This shows that generally speaking there was not an excessive number of individuals exhibiting an idiosyncrasy to arsenic, but the influences of toleration and idiosyncrasy in the individual must not be overlooked. I have met with no evidence of arsenical poisoning in any persons restricting themselves to symptoms spirits. Judging from what has generally been taught not met with it seems a very remarkable fact that even confirmed in spirit drinkers in this district, who have restricted them-

Age and sex distribution

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selves to spirit, rarely present symptoms of peripheral neuritis.

3485. Would you wish the Commission to understand there was no doubt whatever in your mind as to the cause of this outbreak that occurred here?—No doubt whatever. We have proved that the arsenic was in the beer which the affected cases were obtaining from their public houses. We then traced that beer to the brewery, and we are able to find the arsenic in that beer. We also found the arsenic in the excretions from the affected patients, so that we consider all the links in our evidence are complete.

3486. As the completion of the link, were you able to refer the cases to beer which was brewed from Bostock sugars?—We were informed by the brewers that they obtained their sugar from that source, and the sugars that were provided for our investigation were said to have come from Bostock's, and in no case have we been able to trace the sugars to any other source.

More cases
occurred than
were reported

3487. You speak of the reluctance of patients in giving information. Do you mean as regards how much beer they drank, or as regards the symptoms from which they were suffering?—In many cases, even when very poor, the patients did not come to my out-patient department until late in the development of the disease, and long after the cause was popularly known. Apparently amongst the women there was a reticence in letting it be known that they were going to the out-patient department affected with this complaint.

3488. Do you think there was a reluctance on the part of the patients because it might be suspected that they had been drinking a great quantity of beer, and that that might be laid to their charge?—That was their idea I think, in the case of the women especially.

3489. Are you disposed to infer from that that even the number of cases which has come under your cognisance and the cognisance of others in this district might have been increased if there had not been that reluctance—that there have been cases where patients have been suffering from the poisoning and you have heard nothing of them?—Yes. We also know from patients, who stated that friends in their district were affected in like manner; and also I am acquainted with private cases which, as far as I know, have not come within the reach of any statistical return.

3490. You have published the results of all your experience in a book, have not you?—We published the results of our early experience. Since January, of course, we have been accumulating further evidence.

3491. You state here that when neuritic symptoms became marked they were not unnaturally at first thought to be dependent solely on the alcohol?—We had long been acquainted with so-called alcoholic peripheral neuritis in this district, and therefore when these cases first presented themselves with neuritic symptoms, the majority of men not unnaturally thought that it was an increase of the condition which had been long known to us.

3492. Are you aware whether these cases of peripheral neuritis have been more frequent in this district of Manchester and the surrounding district than any other parts of England?—I gather that that is the case, and I have placed that before the Commission in numbers which I have gathered, and which will be found at the end of my statement, which I will refer to a little later on.

Addison's
disease

3493. (Sir William Church.) I should like to ask you a few questions about your experience before the last few months. You stated that what first attracted your attention was Dr. Crawshaw asking you to see an anomalous case of Addison's disease under his care. Do you know whether Addison's disease has been frequent in this district, or what has been supposed to be Addison's disease?—With a view to getting accurate statistics on that point I have looked up the pathological records, for I understand that a number of deaths have been registered in this district as due to Addison's disease during the past year; and therefore to ascertain its customary frequency in Manchester I have examined the pathological records, and of 1,478 medical cases investigated at the infirmary during the period I held the post of pathologist I found only three undoubted cases, or 0.2 per cent.

3494. How many years was it that you held that post?—Eight and a half years, from 1891.

3495. And in eight years there were only three cases

registered as cases of Addison's disease?—There were only three cases met with in the post-mortem room.

3496. And of those which did not come to the post-mortem room can you say anything?—I cannot say.

3497. There was nothing in your experience which makes you think that Addison's disease was supposed to be more frequent in this district than in other parts of England?—Certainly not; if anything I should rather think it was rarer. One of these cases occurred in 1893, the other in 1895, and the last case I made the post-mortem examination on was in 1897.

3498. What was it that suggested arsenical poisoning as the explanation to the officers of the Royal Infirmary?—The number of cases in the infirmary of peripheral neuritis had been occurring in greater frequency than was customary, and as registrar I had the opportunity of seeing all the cases, so that we discussed the question as to what was the cause of the increased frequency.

3499. There was no particular symptom that started you on the right track?—Soon after returning from my summer holidays, amongst my out-patients at Pendleton, I noticed in the men, when I was examining their hearts, that the nipples and areolae were frequently black. I asked the men about this, and they said they had noticed it themselves. I think that was one of the earliest signs I myself personally observed in the autumn.

Pigmen-
tion.

3500. Pigmentation of the areolae of the breast?—Yes.

3501. Were rashes one of the things that attracted the medical officers of the infirmary, and put you on the track?—Pigmentation had been noticed in some of these cases of so-called peripheral neuritis before we realised that that pigmentation was due to arsenic.

3502. It was a review of the whole of the circumstances rather than any one particular symptom which put you upon the right track?—Quite so.

3503. When you saw Dr. Forsyth what information did he give you?—I called upon him on the evening of the 20th, and told him that these anomalous cases were due to arsenic. He had been seeing considerable numbers of these cases. Directly I told him what it was due to he realised in a moment that the solution of the cases was quite simple.

3504. Did he tell you what were the symptoms which had attracted his attention? We have already got it in evidence from Mr. Groves that his attention was drawn to the large number of his employees who were off duty, and on their benefit clubs, and he spoke to Dr. Forsyth about it, but he was not able to tell us what his employees were complaining of?—I understood from Dr. Forsyth that the chief symptoms of these men were irritation of the eyes and a slight irritation of the mucous membrane, nose, and so on; in fact, symptoms a little like influenzal symptoms.

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3505. Catarrhal symptoms?—Yes. Dr. Forsyth also told me he had been seeing a number of cases of herpes, a much larger number of cases than he had met with among the poor of Salford before.

3506. What do you mean by herpes? Herpes as you and I know it, medically speaking? Was it herpes zoster, or herpes about the nose and lips?—No, herpes zoster, the true nerve herpes.

Herp

3507. That you would not consider probably an early symptom, would you? It would be secondary probably to nerve changes?—Apparently so, and yet in many of the cases, as far as I can gather, when they have had herpes, the neuritic symptoms have not been specially marked.

3508. Did he say that many of the brewery employees had been suffering from gastro-intestinal disturbance or not?—He gave me no idea of the numbers, but I gathered that some of them had.

3509. Would not you expect before this disaster that before any serious amount of arsenical poisoning took place you would have got the history of gastro-intestinal irritation?—In the early days of the epidemic most of the practitioners firmly believed that the early symptoms of arsenical poisoning were manifested by gastro-intestinal symptoms, but in many of the cases I have inquired into the gastro-intestinal symptoms have been in abeyance. Another difficulty also presents itself, in that many of these people chronically suffered from gastro-intestinal symptoms. I spoke to one of our patients this morning who said he had vomited for many years every morning. He was in the habit of taking something like 12 pints daily.

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N. 3510. Still the absence of complaint on the part of these people of gastro-intestinal symptoms would render it less probable that the medical men whom they consulted would recognise it as being arsenic?—That was undoubtedly the case.

3511. How did you find that the cases at Heywood, Bacup, and Blackburn compared with yours?—The cases at Blackburn were apparently early cases, and comparatively slight. The cases I saw there were only in the catarrhal stage, and early neuritic irritation stage. I saw no cases of absolute paralysis there, neither did I hear of any.

3512. When did you first see cases of what you have spoke of as skin lesions, leaving out of account herpes or pigmentation; did they come early under your observation or late?—Looking over my notes, I find that early in the summer there were anomalous cases of skin lesion which I did not recognise as being arsenical, but the greater number of them seemed to come as regards Manchester in September and October.

3513. What was the nature of those lesions?—They were chiefly erythemas, but later on we got more extensive lesions. In fact, in one patient I have seen almost all the primary and secondary lesions of the dermatologists. Papular, vesicular, and pustular eruptions, cullous, urticarial, scaly lesions and pigmentation, excoriations, and in some cases itching.

3514. Those cases of marked thickening of the cuticle on the hands and feet that you speak of as keratosis were rather late manifestations?—In some cases they were the symptoms that sent the patient to me. I remember one man distinctly coming to the out-patient department, and saying that his hands were getting so thick that he could not work. That was what struck his attention, but he also had some neuritic symptoms, which, however, had not specially attracted his attention.

3515. Were numbness and tingling of the extremity an early symptom?—Yes, and very common; the majority of patients coming as out-patients presented those symptoms.

3516. Speaking from your experience, how would these symptoms of numbness and tingling accompanied with skin eruption and followed by this thickening of the cuticle on different parts of the body compare with former cases of so-called alcoholic neuritis? Was it within your experience that you met with those symptoms I mentioned, the numbness and tingling to the same extent, the presence of rashes, and the presence of thickening of the cuticle in the cases of alcoholic neuritis which occurred during the eight years when you were pathologist?—In the former cases of alcoholic neuritis I cannot remember any case that had herpes. Very few of the cases presented distinct pigmentation. Erythemas were occasionally present, and the so-called erythromelalgia was sometimes met with. My attention was specially drawn to these cases because I happened to be, as a student, clerk to the late Professor Ross, who investigated these cases in Manchester, and in 1889 I was house physician to Dr. Dreschfeld, who, I believe, was the first to draw attention to peripheral neuritis occurring in beer drinkers in this district in 1884.

3517. So that a good many of these symptoms, according to your experience, has not been so marked in the old cases of alcoholic neuritis?—Pigmentation had not been marked; herpes had not been marked; and the lesions other than erythema had not been specially marked.

3518. That particular lesion of erythromelalgia you speak of you find in cases of nerve disturbance such as when a nerve has been divided?—That is so.

3519. You say in one rural district in which you saw cases where the beer contained as much arsenic as 1·4 grains per gallon the brewer early recognised the pernicious character of his beer. What do you mean by early recognised it?—This was a country district where the brewer superintended the making of his own beer, and he, in the autumn months, found that the men were passing his tied houses and, as he said, preferring tea to beer.

3520. By early you mean early in the year?—Yes, September, I think. I mean early in the outbreak.

3521. Did you find out whether he was using Bostock's material?—Yes, he was; but he did not know it, because he was getting it through an agent, and the agent was getting it from Bostock. He himself,

therefore, did not realise until some time later the source of the sugar.

3522. Do you know what the effects of the beer he sold were on his customers that made him pass his house?—They knew there was something queer about it.

3523. (Professor Thorpe.) Where was this brewery?—It was not far from Warrington.

3524. What was the name of the brewery?—Might I explain just one point here? In our investigations we have acted as private individuals, and we have seen a number of brewers and others who, before any Royal Commission was spoken of, consulted us, and we feel as private individuals that a great deal that has been revealed to us was revealed to us in confidence. Therefore, whilst we are anxious to put everything before the Commission, might we be allowed to write such names down?

(Chairman.) Yes; you can hand it in and leave it for the Commission to decide.

3525. (Sir William Church.) What I want to know is what symptoms were produced in the people who got beer so highly contaminated as this was? Did the people who drank this very highly contaminated beer have vomiting and diarrhoea?—Some of them. I have a letter from the husband of a lady who had taken this beer which is rather interesting, as it gives the layman's idea of the commencement of the symptoms.

3526. I want to get evidence that the more grossly contaminated the beer the more quickly it was recognised that there was something unwholesome in it, and that more definite symptoms probably immediately followed. Whereas when it was less contaminated no symptoms followed for a considerable time?—I think this letter will be evidence. This was a lady who bought some of this beer from this brewery, bottled beer. She and her husband lived together, but her husband left her to go during the day to business in a neighbouring town. Both of them were affected, but she rapidly developed very marked paralysis, which is crippling her now. The husband has kindly sent me this letter, which I asked him to write after I saw the case in consultation with a doctor there. He wrote this on November 30th: "Agreeable with your wish, I give you in some detail the symptoms which have been noticeable in my wife's illness. Some six weeks ago, say October 19th, she was seized with vomiting accompanied by pain in the bowels and purging. That continued for two weeks, followed by difficulty in walking. She gradually got worse in that respect, and experienced very great difficulty in getting up and down stairs—to use her own expression, she felt as if she was walking on springs. Ultimately Dr. ——— was called in, and, after attending her a week or two, ordered her to bed, which she has kept since that time. While confined to bed she has suffered great pain in her lower extremities, and at the present time is unable to stand or walk. Her left foot is slightly turned in, and her hands are very much affected, they burn, and she is quite unable to grasp anything or hold a cup, etc. She is able to move her feet, but the movement causes pain. I should have stated that about the end of the second week she was seized with a violent pain at the bottom of the back. She has become considerably thinner, her arms and legs very much so. As regards myself, I do not suffer any great inconvenience, my feelings being confined to a tenderness and slight burning of the hands and a tingling in the soles of the feet. That has been my experience for some three weeks past."

3527. That would go to show that where the beer was very much contaminated the gastro-intestinal symptoms were amongst the first noticed?—It does; toms. and the beer of that brewery contained the largest amount of arsenic of any.

3528. It has been suggested to the Commission by one witness that the great intolerance shown to the poisonous material, whatever it may be, in beer, led him to think it might be something else than arsenic. Do you think that, considering the enormous number of people who drank the contaminated beer in this district, there has been a very considerable amount of tolerance of arsenic?—I think the evidence goes to show that there certainly has been a certain amount of tolerance amongst many of the cases, but there is also evidence, of which we have had one or two cases, that patients manifesting an idiosyncrasy to arsenic prior to taking the beer, have been readily affected.

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3529. But apart from that. Considering the number of people who have been taking large amounts of contaminated beer, the population generally have shown a tolerance to arsenic, just as we should expect with people who were receiving small and constant doses of arsenic?—That is undoubtedly the case. The number of cases that have occurred compared with the large number of the population in Manchester and Salford is small.

3530. It has been suggested to the Commission that selenium or other substances must have been present to account for the tolerance?—I know nothing about the pharmacology of selenium.

Greater
severity of
disease in
women.

3531. Have you any suggestions to give the Commission as to the reasons why these various cases have been more fatal in women than in men?—There are several explanations. First, I think women are naturally more liable to be affected with alcoholic neuritis, and in many cases these women have not had their excretory organs so active—they have not lost so much by sweating, and in many cases they have suffered from chronic constipation. Also, whilst the men in many instances have taken their beer from a number of public-houses, it is frequently the case, as we have distinct evidence to show, that the women got their beer from a definite public-house. I believe, too, amongst women in this district there is a very marked tendency to take large quantities of beer, and frequently between meals. They go to each other's houses, have a gossip, and the beer is sent in; so that between preparing their husbands' meals they take considerable quantities. I think those are the more particular reasons that explain the sexual differentiation.

3532. (Dr. Whitelegge.) You distinguish three stages in the history of the epidemic. Are those stages in the epidemic as a whole?—Yes.

3533. They do not refer to individual cases?—No. I shall refer to those presently.

3534. You mentioned some cases in He-wood which the medical officer of health said occurred in epidemic form immediately after the Whitsuntide holidays. They were not recognised as arsenical cases at that time?—No, not until after the Manchester cases had been recognised as arsenical.

3535. But those were earlier in date?—Yes. In fact, I saw cases there that dated their illness back to Easter, 1900.

3536. Definite arsenical cases?—Yes.

3537. On November 7th samples of beer from the rural districts to which you referred were submitted to analysis, and arsenic was found on November 17th. I believe that is an earlier date than has been given to us yet?—In making that statement, I quote from a published paper by Mr. Duncan, the analyst, who examined the special beer from this brewer to whom I have referred, and Mr. Duncan, in his published report, has stated that he found it on that date.

3538. Could you give us a reference to the report?—It is in "The Chemist and Druggist" for January 19th, 1901, page 93.

3539. Can you tell us what steps were taken by the brewer in question when this conclusion was arrived at?—I believe he took every step to prevent any further beer going out from his brewery. I cannot say anything with regard to the beer that he had sold.

3540. Can you give us the details?—No.

Cases in
Manchester
Royal Infirmary.

3541. You have given us figures of the cases observed at the Royal Infirmary?—Yes, during the months of November, December, and January.

3542. Would those be the whole of the cases observed there, including in-patients and out-patients?—These are only the in-patient cases, and, therefore, the bad cases. I might say that during this period of November, December, and January these cases formed 12.61 per cent. of the medical cases admitted.

3543. (Sir William Church.) Of course, there would be a large number of such severe cases in the out-patients' rooms?—A very considerable number were sent there, I believe; but I cannot speak to the out-patient department, because all my work is, as registrar, in connection with the in-patients.

3544. (Dr. Whitelegge.) Do you limit these figures to neuritis?—These 43 cases occurring during the months of November, December, and January were typical arsenical cases.

3545. Presenting symptoms of neuritis?—More or

less. In some of them there was marked pigmentation and less neuritis. In some few there was no distinct pigmentation at all.

3546. Can you say how many fatal cases of Addison's disease there were in the year 1900?—As far as I remember there has been no case of undoubted Addison's disease in the infirmary, but I am not absolutely sure. My impression is that there has been no case during 1900.

3547. Do I understand you to say that Dr. Dreschfeld associated peripheral neuritis with beer drinkers in 1884?—Dr. Dreschfeld in 1884 published a paper which I think first drew attention to alcoholic paralysis in this district, and it is interesting to note that in giving the history of this first case recorded in this district he says: "Moreover, in her delirium she continually called out for beer." That is published in "Brain," Vol. 7. I might also add that in that same paper Dr. Dreschfeld in one or two places, in speaking of the differential diagnosis, refers to arsenic.

3548. (Chairman.) Have you anything to say with regard to the different stages of the disease?—According to the severity of the poisoning, the following stages have been recognisable:—(a) stage of mucocutaneous irritation; (b) stage of neuritis; (c) stage of paralysis, with atrophy and deformities; (d) stage of convalescence. A considerable number of cases presented little more than catarrhal symptoms. Many complained of irritation about the eyes and running of the nose. Nasal laryngeal and bronchial catarrh have been common, but marked gastro-intestinal irritation exceptional. Pigmentation was present in the majority of cases, and in some closely resembled that of Addison's disease. I understand a number of deaths have been registered as due to this complaint during the past year, and therefore, to ascertain its customary frequency in Manchester I have examined the pathological records of 1,478 "medical" cases investigated at the infirmary during the period I held the post of pathologist, and I find only three undoubted cases, or 0.2 per cent. The cutaneous derangements have been very multifarious. Herpes has been one of the most characteristic. Keratosis or thickening of the cuticle has made a conspicuous figure. Erythromelalgia was common in the earlier stages. Of the neuritic manifestations the sensory derangements have generally been most troublesome, and usually preceded the motor. The form of paralysis has in the main been similar to that usually met with in so-called "alcoholic neuritis." Mental disturbances have been well marked in many patients. Heart failure has been present in bad cases. Cystitis and retention of urine has been present in a few instances. In no case, as far as I am aware, has the course of pregnancy been interfered with. A considerable number of the cases quickly recovered on the beer being withdrawn, but improvement has been very slow in many. Some are but now gradually passing into the stage of convalescence, and a number are yet under observation where the paralysis is still very extensive, and in some perfect recovery is unlikely. Many of the clinical points are clearly indicated in the series of drawings, photographs, and casts which I have placed on the table. The casts are of particular interest in that they have all been taken from patients under the care of Professor Dreschfeld. For purposes of comparison I have brought a few casts of "alcoholic" cases taken as far back as 1893, and these show that there is practically no difference in the muscles affected in arsenical and alcoholic paralysis, and that the consequent deformities are similar.

3549. Have you anything to say with regard to special cases?—I have seen two infants affected by arsenic through their mother's milk. One case was under the care of Dr. J. H. Taylor, of Weaste. The mother presented typical symptoms of arsenical poisoning. The other case was met with among my own out-patients. The infant was nine weeks old. The mother had been taking stout for five weeks. She presented the usual characters, pigmentation, erythema, and much sensory involvement. Analysis of the milk in both cases gave negative results. It has been generally stated that children have not been affected. This is not altogether the case. On December 2nd I saw, with Dr. John Brown, of Bacup, well-marked evidences of arsenical poisoning in a little girl of two. The child's father, who was also a sufferer, kept a public-house at which arsenicated beer was sold, and the child had been accustomed to get "sups" from the customers. I should

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Stages
of arsenical
poisoning in
beer drinker

Arsenic
poisoning
through
mother's
milk.

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like to mention a curious case where poisoning occurred from the use of arsenical glucose in sweets. My informant is a brewer, who has rendered us much assistance in our investigations, and who has himself, together with several of his workpeople, presented evidences of arsenical poisoning. His beer has proved disastrous to a number of cases, several of which I have myself been able to examine. He writes me as follows: "I have a daughter about eleven years of age, and she and a niece made some toffy of this glucose, of which I believe my daughter ate the most. The first symptoms observed were sickness and purging, very violent. And when she went to school at —, she was under the doctor. She was often sick, and they thought she was suffering from biliousness. After Christmas, when she was at home, her mamma was so alarmed about her, as she was getting so weak, that she took her to Dr. —, of —. I forgot she complained of stiffness in her legs. Dr. —, after examining her, asked if she drank any beer, and was answered in the negative. 'Well,' he said, 'she seems to me to be affected with arsenical poisoning.' Afterwards we learned that she had helped to make and eaten this toffy. She now seems much stronger."

3550. You are a lecturer, are you not, on food inspection?—I give lectures on food inspection to students preparing for their Sanitary Inspectorships.

3551. Have any other cases come under your notice similar to that you have just quoted to us, before this outbreak took place or since?—That is the only case I know of where the poisoning from arsenic occurred other than through beer.

3552. You have not heard of any other case?—I know of no case occurring through sweets or confectionery.

3553. (Sir William Church.) How were the infants affected?—The infants were affected in that whenever they were put to the breast they immediately vomited after taking the milk. The eyes were running, and my own case was scabbed along the lids. The hands and feet were also slightly red. I stopped the suckling at once, and the mother informed me that there was no further vomiting. After a short while she continued to suckle the child, and the child did remarkably well.

3554. What was the age of the children?—In my own case the infant was nine weeks old, and in the other case the child was a few weeks old.

3555. It is a very common symptom for children to be sick after having had the breast, is it not?—Yes; but in this case both mothers were suffering from arsenical poisoning, and within a short time of their improvement the children got quite right. The child also had erythema and conjunctivitis, and there was also wasting.

3556. Had it any diarrhoea?—I am not prepared to say without referring to my notes.

3557. It seems to me one would want a little more proof than the mere fact of two children at the breast being ill in a way not uncommon with children at the breast, before one is quite sure they were suffering?—Both mothers were suffering acutely from arsenical poisoning.

3558. Has arsenic ever been found in milk?—Yes; and Professor Wood, in his work on Therapeutics, refers to the presence of arsenic having been found in a number of the excretions, sweat, and skin, and hair.

3559. You had not an opportunity of examining the milk yourself?—We obtained the milk on two occasions from the case, and my colleague, Mr. Kirkby, examined it. We had, of course, only a small quantity of milk, 1½oz. to 2oz., and no arsenic was found in the milk. The second sample was taken after all beer had been stopped.

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3560. (Chairman.) I believe you have something to say with regard to dosage?—With regard to the important and interesting question of dosage it would seem that comparison between the amount of arsenic taken in medicinal preparations, and that consumed as arsenicated beer is apt to lead to fallacious conclusions. The effects of the arsenic upon the system in the recent outbreak have been considerably modified by concomitant conditions. Our investigations go to show that the peculiar circumstances of the introduction of the poison have led to an increase in the rate of absorption, to exceptional accumulation in the body, and to a retardation in its elimination. I am also of opinion that the alcohol, or other ingredients of the alcoholic beverages taken, has in many instances greatly accentuated the effects of the poison. A consideration of such circumstances will help to explain many cases

where patients have only consumed very moderate quantities of beer or stout, and yet suffered severely. Of these I have seen several. The amount of arsenic in the various beers has varied greatly, even when the beer has come from the same brewery. This is clearly demonstrated by the Table on page 90 of our book, where the amount from brewery C has varied from 0.2 to 0.01 grs. per gallon. The amount of arsenic in the glucose and invert sugars varied from 0.03 to 0.05 per cent. Also the proportion of sugar used by different brewers to displace malt has varied from 10 to 50 per cent. Strange to say, many brewers seem to be in the habit of always mixing the sugars received from different firms. It is therefore readily seen that the arsenic present in the beer has varied within such wide limits that it is almost impossible to ascertain the exact amount taken by the patient. For instance, if a person drank a beer which contained 14grs. per gallon, and took half a pint of this, that would mean only taking 1-100th of a grain of arsenic at a time. Many, however, have taken quite a gallon of beer daily, and that would mean something like a sixth of a grain daily. But some cases have come under our observation where beer has been taken from a brewer who was using 50 per cent. of contaminated glucose, and here the dosage was equal to 1.4gr. per gallon.

3561. With regard to this varied quantity of arsenic found in beer manufactured by one brewer, it might be perfectly true, but at the same time you are of opinion that the only real security is to allow no arsenic whatever in any material used for brewing?—Certainly; as defined by a statutory test.

3562. You would have a statutory test applied?—Certainly.

3563. And apply that test in the form of an analysis of all material used in brewing?—Certainly.

3564. (Sir William Church.) What leads you to the opinion that alcohol or other ingredients of alcoholic beverages has in many instances greatly accentuated the effects of the poison?—First, that in those cases that were very moderate drinkers the symptoms subsided much more rapidly than in the excessive drinkers; also, in some of my patients when I knocked them off the beer I found they were not improving as I expected, and on inquiry I found they had transferred their affections to rum and spirits. In one or two cases I found a man who had been improving relapsed, and on inquiring I found he had returned to his beer, fully understanding that the beer now contained no arsenic, and yet it brought back his sensory symptoms and symptoms to a slight extent of erythema.

3565. It comes to this, then, that you think the person who does not use alcohol at all, or at all events not in large quantities, possesses extra powers of resistance. You did not think that the fact of the alcohol and arsenic being ingested together caused the arsenic to have special virulence?—I have only formed the opinion as regards the clinical facts, which seem to give an explanation.

3566. It has been stated by many other witnesses that they thought the ingestion of alcohol and arsenic together was likely to be more deleterious than the ingestion of arsenic alone?—I am convinced of the fact as evidenced in my own patients, but as to how this association acts I am not quite sure.

3567. (Dr. Whitelegge.) Why do you think that the absorption of arsenic is more rapid?—The absorption of arsenic, we think, is more rapid than in the case of medicinal doses, in that apparently the vehicle has exerted some influence, because in many of these cases I have endeavoured to take the data, and have found in one or two cases that these symptoms of arsenical poisoning developed in one case within a week, and in one or two other cases within a fortnight. We know approximately what amount of arsenic those beers contained, and medicinally speaking we do not generally get with roughly comparable doses symptoms of arsenical poisoning within a week. In the case of a man who came from Canada and landed in this country on September 10th, within a fortnight he had very distinct symptoms. I saw him in Heywood and in six weeks he had very marked and distinct pigmentation.

3568. From what circumstances do you conclude there is exceptional accumulation in the body?—My colleague Mr. Kirkby has examined specimens of skin taken from patients, and in several of these we found what I think I might call a considerable amount of arsenic. In one case, for instance, a comparatively small quantity of scales gave a very distinct mirror with Marsh.

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Effect of administration of arsenic and alcohol together.

Instance of rapid development of symptoms.

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3569. And gave results you did not expect to find from ordinary medicinal administration of arsenic?—Not from my own experience.

3570. You have not any precise comparative results?—Not at present.

Excretion of
arsenic.

3571. Why do you say there is a retardation in the elimination? Is that based on experiment?—Yes. It is generally believed that arsenic is excreted rapidly, but our recent experience has conclusively shown that arsenic may act as a cumulative poison. Mr. Kirkby has carried out a series of analyses with regard to this point, which show that a continuous elimination of arsenic by the kidneys may occur during a period of six weeks after stopping all contaminated beer. In a patient of Dr. Dreschfeld's after five weeks residence in hospital, arsenic was obtained from the desquamated skin in such quantity as to give a very distinct mirror with Marsh's test. It has been detected in the hair of a number of the cases, and, as already indicated, it can pass into the milk of suckling mothers in sufficient quantity to cause poisonous symptoms in their infants.

3572. (Chairman.) How many years were you pathologist at the infirmary?—From early in 1891 to nearly the end of 1899, since which period I have been medical registrar. My connection with the infirmary has, therefore, been continuous since 1891, and I have known of cases there as a student and hospital resident.

Alcoholic
neuritis in
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3573. There is one important part of your *précis* which we should like you to enlarge upon, as, if it be a fact, it is important. I refer to your statement that in this particular district for many years past, and long before this outbreak took place, there were a large proportion of these symptoms as compared with other districts in the country?—When pathologist at the infirmary, I was much struck by the large number of cases coming under observation with alcoholic lesions. As far as could be ascertained they were nearly always beer drinkers. I then formed the opinion and constantly taught that either the drinking habits of the people or the character of the beverage in this district was more fruitful in pathological results than appeared to be the same elsewhere. In 1895 ("Medical Chronicle," December, 1895, p. 180) I collected the fatal cases of alcoholic neuritis which had been submitted to post-mortem examination during the preceding three years. Eight cases had been examined. They formed 1.6 per cent. of all the medical cases examined during that period. All were females. The average age was 39. The oldest was 57, the youngest 24. I have the reference to these cases here. As it has been stated that phthisis has been hastened in certain of the recent arsenical cases it is interesting to note that of these eight fatal cases, seven were the subjects of pulmonary tuberculosis. It may not be without interest to add that in 1897 I collected 121 cases of common cirrhosis of the liver from amongst our pathological records of 3,053 medical cases. In these, either active, latent, or obsolete, tubercle was met with in nearly 24 per cent., and over 12 per cent. died from active tuberculosis. It also seems to me a very suggestive fact that we have for long looked upon "alcoholic heart" as a particularly well marked pathological condition, and easily recognised clinical affection in Manchester beer drinkers. In the following tables I have indicated the number and relative frequency of cases of peripheral neuritis amongst the patients of the Manchester Royal Infirmary since 1892 as recorded in our official returns:—

FREQUENCY OF PERIPHERAL NEURITIS AMONGST MEDICAL IN-PATIENTS OF THE MANCHESTER ROYAL INFIRMARY.

Year.	Total Cases.	Number of Peripheral Neuritis.	Percentage.
1892	1,376	21 (a)	1.52
1893	1,374	23 (b)	1.67
1894	1,286	17 (c)	1.306
1895	1,249	16	1.28
1896	1,317	13 (d)	0.98
1897	1,286	12	0.93
1898	1,412	7	0.49
1899	1,300	21	1.61
1900	1,343	62	4.61

(a) Of these 21, 12 are definitely returned as "alcoholic neuritis."

(b) " 23, 20 " " " " "

(c) " 17, 13 " " " " "

(d) " 13, one was considered as probably post-diphtheritic, another possibly syphilitic.

As regards the year 1898 I have been somewhat perplexed, as the numbers then fell to seven, a percentage of .49. I believe it has been stated before your Commission that the number of deaths from alcoholism in 1898 in this district was smaller than in previous years. If that is so, it would help me out of the difficulty of explaining this fall in the cases. I endeavoured to check that by taking the home patients, visited at their own homes. I find in 1894 the percentage was 0.52, but in 1898 there was only one case, whereas in 1899 the percentage again went up to 0.46, and in 1900 there were 76 cases of peripheral neuritis returned as having been seen in their own homes, a percentage of 9.22.

3574. (Chairman.) That was apparently a period during which this epidemic took place?—That is so. But, even taking the whole of our cases, 11,943 cases, since 1892, I find we have 192 cases, with a percentage of 1.59. It is quite possible that one or two of these may have been post-diphtheritic.

3575. Were those cases of peripheral neuritis?—Yes,

3576. (Chairman.) I understand you have sought to compare the Manchester experience with that of other districts. Could you give us the result of your comparison?—Yes. Reliable statistical evidence, as might be expected, is somewhat difficult to obtain, but such as has been forthcoming tends to show that Manchester and district has long enjoyed an unenviable prominence as regards the frequency and severity of its cases of peripheral neuritis. I have endeavoured to take what I may term characteristic centres. London experience, as indicated in the official reports of St. Thomas's and St. Bartholomew's Hospitals, shows that for the years 1893-1896 about $\frac{1}{2}$ per cent. of the medical in-patients were returned as suffering from peripheral neuritis. Professor A. Carter, of Birmingham, has kindly sent me returns of the Queen's Hospital, from which it appears that between 1891 and 1900, 84 cases were registered as "alcoholic," "peripheral," or "multiple," and therefore presumably of similar character. Through the kind intervention of Professor Sims Woodhead I have been furnished with the returns of cases of alcoholic neuritis in Addenbrooke's Hospital, Cambridge, which may be taken as representative of the experience of our eastern counties. Between 1878-1901, 26 cases of alcoholic neuritis were returned, 11 being males and 15 females. The average age of the men was 43.72, that of the women 41.46. Of the total cases only 0.28 per cent. of peripheral neuritis occurred, 0.27 per cent. males and 0.29 per cent. females. Through the kindness of Dr. Burton Fanning, of the Norfolk and Norwich Hospital, I have learnt that in that institution, since 1890 only 25 cases of peripheral neuritis have been met with. With many of these cases it has been difficult to be sure of the exact form of drink taken, but 5 are definitely recorded as beer drinkers, and 3 admitted taking beer and spirits. In Cornwall "alcoholic" neuritis seems to be almost unknown. Dr. J. B. Montgomery, of the Cornwall Dispensary and Infirmary, Penzance, in over 50 years' experience has recollection of only one case. If peripheral neuritis was commonly due to alcohol, it should be frequent in Scotland. As far, however, as I can ascertain, such is not the case. While whisky appears to be the popular drink, I am informed on reliable authority that a good deal of beer is also consumed. Dr. Mackie Whyte has very kindly sent me an analysis of the cases of alcoholic neuritis in Dundee Infirmary during the last three years. Out of about 9,000 patients, 9 cases were met with, which gives only 0.1 per cent. In 5 of the cases "spirits" was stated as the cause. That peripheral neuritis is, however, not unknown in Edinburgh is clear from the fact that Dr. Clouston, superintendent of the Royal Asylum, Morningside, is able to report that for the year 1900, 13 per cent. of the male and 9 per cent. of the female alcoholic patients exhibited symptoms in varying degrees. Dr. Wigglesworth, of the Lancashire County Asylum at Rainhill, writes me that for the two years, 1899 and 1900, the proportion of well-marked peripheral neuritis in the strictly alcoholic cases was 2.27 per cent. for the males and 4.76 per cent. for the females. Multiple neuritis would appear also to be rare in Ireland. Professor J. A. Lindsay, of Belfast, has sent me very carefully-prepared statistics of the cases met with in the Royal Victoria Hospital from 1892-1899, showing that during that period only 23 cases have been met with amongst the in-patients, which give a return of 0.29 per cent. Professor W. E. A. Cummins, of Queen's College, Cork, informs me that alcoholic neuritis is very infrequent in that city.

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N. although "porter is the usual beverage taken by the lower classes, not whisky." I have endeavoured to obtain particulars of the occurrence of peripheral neuritis in America, where I believe much of the beer taken is prepared from glucose and invert sugars. Professor Osler, of Baltimore, has very kindly sent me a preliminary announcement, in which he says: "We see very little severe alcoholic neuritis, and it is my experience, I think, entirely in whisky drinkers. . . . I do not remember at the moment ever to have seen in this country a case of alcoholic neuritis from beer." An arrangement of these results in tabular form shows at a glance that for nine years at least peripheral neuritis has been common in Manchester:—

ANALYSIS OF CASES OF PERIPHERAL NEURITIS OCCURRING IN-PATIENTS IN VARIOUS HOSPITALS.

Hospital.	Years.	No. of Cases.	No. of Peripheral Neuritis.	Per-centage
Royal Infirmary (Dundee).	1899-00	9,000	9	0.1
Addenbrooke (Cambridge).	1878-01	9,096	26	0.28
Royal Victoria (Belfast).	1892-99	7,828	23	0.29
St. Thomas' (London).	1893-96	7,656	37	0.48
St. Bartholomew's (London).	1893-96	10,009	52	0.51
Royal Infirmary (Manchester).	1892-98	9,300	109	1.17
Ditto	1899	1,300	21	1.61
Ditto	1900	1,343	62	4.61

For the years 1892-1898 it accounted for 1.17 per cent. of the in-patients in the Royal Infirmary. In 1899 this rose to 1.61, and last year it was 4.61 per cent. It would therefore seem as though cases of peripheral neuritis had for long been from five to ten times more numerous here than in Belfast and Cambridge and Dundee, and more than twice as frequent as in London. A recognition of such facts has led to the suggestion that poisoning from arsenicated beer has been occurring for some time prior to the recent outbreak, and such indeed seems very likely, but I cannot agree with the view that alcoholic paralysis—which we know has been recognised in this country for over a hundred years (Lettsom, J. C., "History of some of the Effects of Hard Drinking," London, 1789), and has been described in America (Jackson, James, "On a Peculiar Disease resulting from the use of Ardent Spirits," "New England Journal of Medicine and Surgery," Vol. XI., Boston, 1822)—has throughout been due to arsenical contamination of the alcoholic beverages.

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3577. (Chairman.) Do you draw a conclusion from that that there has been something in the quality of the beer consumed in Manchester that has caused this increased percentage of the disease?—As I taught my students long since, and I am still of the same opinion either in the quality of the beer or from the drinking habits of the people there must be something to account for the increased proportion. I am, naturally, unable to compare the drinking habits of Manchester with London, but I should imagine that as regards mere quantity there would not be much difference.

3578. (Professor Thorpe.) With reference to that last statement, I suppose the Revenue returns would show how far there was a great increase in the consumption of beer?—I imagine that would be the case, but I have not looked up those returns.

3579. You would be at once able to satisfy yourself on one of the issues that you put to yourself by simply consulting the Revenue returns?—To some extent as regards quantity; I am not quite sure as regards times. For instance, the women here drink much between meals. I do not know that those medical details would come out.

3580. The only point that would come out would be the total amount of beer consumed?—Quite so. I think the whole circumstances of the way in which the beer has been taken has had a great effect.

3581. (Sir William Church.) Is ascites a common cause of death in Manchester?—We get a considerable

number of cases of ascites in cirrhotic livers, but the majority of our cirrhotic livers are not of the old fashioned gin-drinker's type.

3582. You mean they are not contracted livers?—They are not contracted livers. The majority of them are what we call enlarged fatty cirrhotic livers.

3583. I notice that among those cases that you referred us to, that are published, there are some cases that had livers under the normal weight—two?—Yes. I have met in the post-mortem room with thorough atrophic cirrhosis, contracted "hob-nail" livers, but the majority of the cases that we get are enlarged and fatty cirrhotic livers.

3584. I think your experience is that the cases occurring in this district with ascites, without accompanying heart disease, are generally associated with large and fatty livers rather than with small and contracted ones?—That is so; and also I have seen as a pathologist a large number in alcoholic subjects dying from pneumonia, and alcoholic heart, in which the livers were enlarged, fatty, and cirrhotic.

3585. Besides the condition of the liver, are there any other conditions which you associate with alcoholism in the internal organs as recognisable after death?—In this part of the country we frequently see the so-called "alcoholic heart," the enlarged heart, hypertrophied and dilated with degenerate muscle, and nearly always occurring in beer drinkers.

3586. Do you know what is the supposed action of arsenic upon the heart muscle?—It brings about fatty degeneration, and that is very much the appearance that we find on microscopically examining the muscles of these so-called "alcoholic hearts."

3587. As far as your experience goes, you would say that the hearts of patients that you have thought have been alcoholic have not been so remarkable for what is called fatty infiltration, but for fatty degeneration?—In many cases the two pathological processes have been associated—fatty infiltration and fatty degeneration, but although I have not examined them all microscopically, from those that I have examined I am convinced that fatty degeneration is a very important element in what we clinically know as "alcoholic heart."

3588. You say that alcoholic neuritis has been recognised for 100 years. I suppose you mean by that that the first descriptions almost that we have of it, Dr. Lettsom's, are 100 years old, but you do not wish the Commission to understand that alcoholic neuritis has been recognised generally for 100 years in England?—The description of Dr. Lettsom, over 100 years ago, is what we now know to be alcoholic neuritis; but I think it is generally accepted that it only came into the nomenclature of diseases in 1885, if I remember rightly.

3589. It was recognised before it came into the nomenclature of disease, but until it came into the nomenclature of disease it was not generally recognised by practitioners?—Not by the profession as a whole.

3590. Therefore the experience 50 years ago of your Cornwall correspondent goes for very little more than 15 years' experience?—Yes, unless, of course, his memory was retrospective.

3591. And unless he was acquainted with the fact of alcoholic neuritis?—Yes.

3592. I suppose you would agree with me that 15 years ago the large majority of practitioners in the country did not recognise it?—That is so. In this particular case of Dr. Montgomery, it was father and son who were in medical practice, and if there had been analogous cases of paralysis probably they would have them in their notes and be able to carry them retrospectively.

3593. You asked for analogous cases of paralysis, not for alcoholic paralysis?—I think in asking I asked for alcoholic neuritis. I would leave it to them.

3594. Did you get any other information from Cornwall?—I had the information that they were greater tea drinkers than alcohol drinkers. I believe a large number of the population are abstainers.

3595. Did you inquire of Dr. Montgomery because of the connection that Cornwall has with the manufacture of arsenic?—Partly with that idea.

3596. Do you know whether many workers in arsenic came under Dr. Montgomery's notice?—I cannot tell, so far as the Penzance district is concerned.

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Cirrhosis of liver.

Degeneration of heart muscle, "Alcoholic Heart."

Introduction of Alcoholic neuritis into nomenclature of disease.

Alcoholic neuritis in various parts of the country.

Dr. T. N. Kelynack. 3597. With regard to the information you got from London, in what terms did you ask for it?—I took the returns of St. Thomas's and St. Bartholomew's from the published hospital reports.

3598. I cannot answer for St. Thomas's, but I think in St. Bartholomew's reports the alcohol cases are enumerated separately from the other peripheral cases. I am not certain, but I think that under the head of multiple neuritis there are two sub-headings—alcoholic and multiple?—I can give you the exact numbers.

3599. It is not the numbers we want, but rather the way in which you abstracted those figures from large statistical tables?—I have a table here which I had prepared for my own purposes of reference. It shows the way in which they are given in the hospital reports.

3600. That is just the point I wanted to know; these are medical cases of neuritis?—Yes, under the head of alcoholism at St. Bartholomew's.

3601. You only extracted the ones under the head of alcoholism?—Yes; I think they call it alcoholic paralysis.

3602. I ought to know myself in the case of St. Bartholomew's but I do not feel clear at the moment. All that I wanted to bring to your attention was that unless they were spoken of as alcoholic a large number of the cases of neuritis at St. Bartholomew's would be diphtheritic?—Quite so, but I took care to exclude those. These are all under the head of alcoholism; the diphtheritic ones I think you will find separately.

3603. Have you had an opportunity of getting any information from Poor Law infirmaries?—I have endeavoured to do so, but, unfortunately, statistics do not seem to be available.

3604. The cases from Poor Law infirmaries would be, perhaps, more comparable with your figures here than those from hospitals, would not they?—That is the case, but I am afraid statistics are not available. I have endeavoured to get them from the East-end of London, for instance.

3605. (*Dr. Whitelegge.*) Have you been able to ascertain the percentages for Birmingham or Norwich?—Professor Carter, of Birmingham, has kindly sent me the numbers, but hitherto I have unfortunately not been able to get the full number of the medical cases in order to work out the percentage.

3606. You have obtained the numerator, but not the denominator?—Quite so? I should like to say that when I was working out the cirrhosis of the liver cases it was partly the experience of Birmingham that led me to look up our Manchester cases. Dr. Foxwell had been working at them in Birmingham, and I find that as regards cirrhosis of the liver our Manchester experience apparently is very similar to that of Birmingham, but as to the percentage I am sorry to say I have not got that of Birmingham.

3607. In the case of Cornwall, did you make application to any other surgeon than the one whose figures are given?—I have not done so.

3608. You did not make any application to Plymouth or Tavistock?—No.

3609. The Devonshire towns, probably, would receive the cases from the east of Cornwall?—Yes; in fact I was anxious more to get the neuritis, which is looked upon as alcoholic, and to keep out any that might be due to arsenic in the arsenic centres.

3610. I gather that you have obtained the figures from Cornwall and Penzance rather by reason of their association with arsenic; it was alcohol that you wanted?—I think Sir William Church referred to that. I meant to say that I wanted to know whether there was any alcoholic neuritis or evidence of arsenical beer.

3611. No relation to the local arsenic?—No.

3612. (*Sir William Church.*) I thought it was with reference to the arsenic?—And that is why, of course, I went to Penzance rather than to the other places.

3613. (*Dr. Whitelegge.*) To keep out of the way of the arsenic?—Yes.

Beri-beri and arsenic. 3614. With reference to Dublin, in your book you mention beri-beri. Have you followed that up at all? Have you seen beri-beri?—Dr. Conolly Norman very kindly sent me a copy of his pamphlet, which contains a description of the outbreak in the Richmond Asylum, Dublin. At the time, of course, I carefully went through it, especially as we know that some of the arsenical cases have been confused with beri-beri; but as far as I can gather

from his cases, although the photographs are somewhat similar to our cases, there is no distinct evidence to show that his outbreak was arsenical, for I find no reference whatsoever to pigmentation, for instance, and such skin lesions as we have met with here. I have also looked up Dr. Manson's work, who may be considered to be one of the authorities on beri-beri. I may also say that Dr. Manson has seen some of our cases here, and in his book on tropical diseases, in giving a description of beri-beri, he makes no reference to pigmentation. Of course, pigmentation would be difficult to see in a dark-skinned race.

3615. You could see nothing approaching the ordinary oedema of beri-beri in the recent cases here?—No, but I should like to say in that connection that in the alcoholic hearts that we have here we get curious oedemas. I have seen localised oedema of the chest, and the oedema even localised to the scalp.

3616. Frequently?—Not frequently.

3617. As an exceptional condition?—Yes.

3618. The Royal Infirmary figures of 1898 were rather exceptional, were they not, in giving a lower proportion than usual of neuritis cases?—They were very exceptional.

3619. I see there is another peculiarity in the figures of that year; the total number of medical cases was greater than in any other year. Was there any crowding of the infirmary during that year that would account for the exclusion of neuritis cases?—Not that I am aware of.

3620. There was nothing exceptional?—No.

3621. The total number of cases reported was larger in that year, was it not?—Yes, I noticed that myself, but I am not aware of its exact cause. I endeavoured to check that point by turning to the returns of the home-patients, and I found that in the home-patients in the year 1898 only one case of peripheral neuritis was met with by the visiting medical officers, which seemed to show that they were not kept out of the infirmary by crowding with influenza or pneumonia patients.

3622. (*Chairman.*) You conclude, I believe, with a suggested remedy against the catastrophe that has lately visited their neighbourhood. You suggest, do you not, that as sulphuric acid is liable to contain arsenic, that, therefore, in all cases where it is to be applied for food purposes or for beer there must be some security that it is arsenic free?—That is so.

3623. You approve that suggestion thoroughly?—Thoroughly.

3624. You say: "It is desirable that analytical laboratories be established directly under the control of the local authorities, but subject to systematic inspection by experts acting under the direction of the central authority." Do you approve of that suggestion?—Yes.

3625. Who do you refer to as the central authority—the Inland Revenue or the Local Government Board?—The Local Government Board.

3626. This should be a systematic inspection on the part of the Local Government Board as the central authority of all these analytical laboratories?—Yes. There should be local analyses which might be directed and checked by experts appointed, and reporting to a central authority. It is not a question merely, I take it, of sulphuric acid, but, as I have suggested, sulphuric acid and all materials used in the manufacture of beer and food products should be required by law to be arsenic free as indicated by a statutory test, and that for the enforcement of the same it is desirable that analytical laboratories be established directly under the control of the local authorities, but subject to systematic inspection by experts acting under the direction of the central authority.

3627. You would subject these materials, whatever they may be, to a secure test; that is to say, at all stages you would not be satisfied with any analyses of the product, but you wish to establish a system whereby all materials would be tested which might by any possibility contain arsenic?—I take it that in connection with the local control the final products would be tested, and that those chiefly would be subjected to analysis. I take it, further, that the makers of these food products would throughout, from the commencement of the manufacture to the final form of the food product, for their own purposes see that they had adequate analysis proving the purity of their materials.

Dr. Kelynack. 25 Mar.

Eden cases. alcoholic heart.

A better system of public control as to the security of food.

Mr. WILLIAM KIRKBY, called; and Examined.

Mr. Kirkby. 3628. (Chairman.) I believe you are a Fellow of the Linnean Society, a Fellow of the Royal Microscopical Society, a pharmaceutical chemist, and lecturer on pharmacognosy at Owens College, Manchester?—Yes.

3629. I think you have taken a prominent part in the analytical work connected with this inquiry?—I have.

3630. We shall be glad if you will give us the results of some of your inquiries?—I had some of these suspected beers submitted to me by Dr. Kelynack, and I immediately found that there was a difficulty in analysing them in the ordinary way, that is, by using Marsh's test and Reinsch's test. I saw the necessity of finding out the most delicate method that could be used for detecting arsenic, and I therefore had recourse to Gutzeit's test, which consists of acting upon zinc with either hydrochloric acid or sulphuric acid for the evolution of hydrogen, and in the presence of arsenic there is produced arseniuretted hydrogen, which, acting upon a piece of paper moistened with silver nitrate or mercuric chloride, gives characteristic colours. I adopted the mercuric chloride, which is an improvement on the older method of using silver nitrate. My experience confirms the fact that it is an improvement. Because of the difficulty I had in detecting arsenic with the ordinary tests I had recourse to Gutzeit's test, by means of which I obtained the results set forth in my communication and in the book which Dr. Kelynack and myself have published. The opportunities for applying this test and arriving at an estimate of its value have been great. One of the largest breweries in the Manchester district submitted for examination all the different beers which they had upon the premises, as well as others which were specially brewed, with a view to elucidate the matter in hand, and in order to estimate aright the influence of sulphur compounds which are apt to interfere with the test. I made a considerable number of experiments, and I had a sample of beer brewed with an average amount of glucose free from arsenic and a good proportion of sulphurous preservative. I may say that the quantity used was about an ounce of potassium meta-bisulphite to the barrel; I was able in that way to estimate the amount of influence the sulphur compounds would be likely to have in invalidating the test. From the figures which I have given, I think it will be clear that I have been able to come to a safe conclusion with regard to the quantities which I have stated were present in the beers. Although a process of estimation such as this appears to lack that definiteness which is ascribed to a gravimetric analysis, it is questionable if really it is less accurate when the numerous operations of a gravimetric analysis are considered. But no further claim is made for the following figures than that they are close approximations to the actual proportion of arsenic present in the beers. In order to safeguard an important examination of this character and to arrive at results which might be presented with some degree of confidence, it has been necessary to make many hundreds of experiments. In the following tables the results of the estimations are expressed in grains of arsenious oxide (white arsenic, As_2O_3) per gallon. From a purely scientific point of view it would, perhaps, have been preferable to use the element arsenium (As) as the basis of calculation, but I have adopted the former alternative in order to facilitate a correct apprehension of the dosage.

TABLE of BEERS, PORTERS, STOUT, &c.

BREWERY A.

Article.	Arsenious Oxide, Grains per Gallon.	Remarks.
1. Draught beer	Nil	Bought since outbreak.
2. " " "	"	" " "
3. Bottled ale	0.04	Bought Nov. 27.
4. " " "	Faint trace	From brewery; brewed Aug. 8.
5. " " "	0.18	" " " Nov. 9.
6. " " "	0.28	" " " Oct. 29.

BREWERY B.

Article.	Arsenious Oxide, Grains per Gallon.	Remarks.
7. Draught bitter	Nil	From brewery; brewed Nov. 15.
8. Bottled stout	Very faintest trace.	" " " " 7.
9. Pale ale	Faintest trace	" " " " 14.
10. Draught stout	0.03	" " " " 14.
11. Pale ale	0.16	Bought Nov. 15.
12. Draught ale	1.40	From brewery, September.

BREWERY C.

13. Beer	Nil	From brewery; malt only.
14. " "	"	ditto ditto.
15. Wort	"	ditto ditto.
16. Beer	"	ditto ditto.
17. " "	"	ditto ditto.
18. " "	Very faintest trace.	ditto ditto.
19. " "	Very faintest trace.	ditto ditto.
20. " "	0.01	ditto Malt and Glucose.
21. " "	0.04	ditto ditto.
22. " "	0.04	ditto ditto.
23. Pale ale	0.05	ditto ditto.
24. Beer	"	ditto ditto.
25. " "	0.07	ditto ditto.
26. " "	0.07	ditto ditto.
27. " "	0.08	ditto ditto.
28. " "	0.09	ditto ditto.
29. " "	0.09	ditto ditto.
30. " "	0.10	ditto ditto.
31. " "	0.11	ditto ditto.
32. Stout	0.14	ditto ditto.
33. Beer	0.14	ditto ditto.
34. " "	0.14	ditto ditto.
35. " "	0.14	ditto ditto.
36. " "	0.18	ditto ditto.
37. " "	0.20	ditto ditto.

BREWERY D.

38. Stout	Faintest trace	From brewery.
39. Bitter beer	0.07	ditto.
40. Best XX	0.07	ditto.
41. Common X	0.09	ditto.

BREWERY E.

42. X ale	Nil	From brewery.
43. Stout	"	ditto.
44. Luncheon ale	"	ditto.

BREWERY F.

45. Best beer	Nil	From brewery.
46. Stout	"	ditto.
47. Common beer	0.03	ditto.

BREWERY G.

48. Beer	Nil	From Brewery.
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Mr. W. Kirkby.
25 Mar. 1901.

Mr.
W. Kirkby.
25 Mar. 1901.

BREWERY II.

49. Beer	- -	Faintest trace	From brewery.
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VARIOUS.

Article	Arsenious Oxide, Grains per Gallon.	Remarks.
50. Beer	Nil	Bought.
51. " "	"	- ditto.
52. " "	"	- ditto.
53. " "	"	- ditto.
54. " "	"	- ditto.
55. " "	"	- ditto.
56. " "	"	- ditto.
57. " "	"	- ditto.
58. " "	"	- ditto.
59. " "	"	- ditto.
60. " "	"	- ditto.
61. " "	"	- ditto.
62. " "	"	- ditto.
63. " "	"	- ditto.
64. " "	"	- ditto.

FROM PATIENTS.

65. Beer	- -	Nil	Brewery A. November 23.
66. " "	- -	0.02	- ditto.
67. " "	- -	0.03	- ditto.
68. Stout	- -	0.04	- ditto.
69. Beer	- -	0.07	Brewery C.
70. " "	- -	0.07	- ditto.
71. Porter	- -	0.08	Brewery C. November 23.
72. Beer	- -	0.14	Brewery A.
73. " "	- -	0.14	- ditto.

The various beers, etc., may be placed in four groups:

- Exceeding 0.1 ($\frac{1}{10}$) gr. As_2O_3 per gallon.
- Exceeding 0.03 ($\frac{3}{100}$) gr. As_2O_3 per gallon, but less than 0.1 ($\frac{1}{10}$) gr.
- Less than 0.03 ($\frac{3}{100}$) gr. As_2O_3 per gallon.
- Gave no reaction in one hour by the method adopted, and returned as arsenic free.

The specimen marked No. 12 is worthy of special notice. It was speedily recognised as having a very unusual effect upon the persons drinking it, and as early as November 7 the brewer had it submitted to analysis, but nothing deleterious was found in it. However, other samples were sent for examination, and there were variously reported upon as severally containing 0.8 gr. (approximately) per gallon, 1.12 gr. per gallon, and 1.36 gr. per gallon. Without any previous preparation this beer gave a distinct mirror in a Marsh-Berzelius tube upon being heated for one hour; there was no difficulty in obtaining distinct recognisable crystals of arsenious oxide with Reinsch's test. Nos. 18 and 19 were brewed from all malt and hops, but were nevertheless contaminated with arsenic. The brewing materials of this particular firm were, with the exception of the brewing sugars, found to be free from arsenic. Subsequent brews, however, have been found to be free from arsenical contamination. The suggestion that arsenic is present in the brewing apparatus, such as indiarubber tubing, is worth investigating; but a much more likely source of contamination is to be found in the wooden plant of the brewery, which has been used for brewing arsenical beers for at least several months, as well as in the yeast, which will probably be found to be contaminated with arsenic after having undergone a period of fermentation in an arsenical beer.

Arsenic per-
haps remains
in brewing
plant

BREWING GLUCOSE AND INVERT SUGAR.

Mr.
W. Kir
25 Mar. 1

Article.	As_2O_3 per Cent.	Reaction with Litmus.
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ENGLISH.

1. Invert sugar	- -	Nil	Acid.
2. " "	- -	"	Neutral.
3. " "	- -	0.03	Acid.
4. " "	- -	0.03	"
5. " "	- -	0.04	"
6. Glucose	- -	Nil	"
7. " (for stout)	- -	"	"
8. " "	- -	"	"
9. " "	- -	0.04	"
10. " "	- -	0.05	"
11. " "	- -	0.05	"

AMERICAN.

12. Glucose	- -	Nil	Faintly acid.
13. " "	- -	"	Neutral.
14. " "	- -	"	"
15. " "	- -	"	"
16. " "	- -	"	"
17. " "	- -	"	"
18. " "	- -	"	"
19. " "	- -	"	"
20. " "	- -	"	"
21. " "	- -	"	"

UNKNOWN ORIGIN.

22. Glucose	- -	Nil	Acid.
23. " "	- -	"	"
24. " "	- -	Faintest trace.	"
25. " "	- -	"	"
26. " "	- -	"	"

The proportion of sugar used for displacing malt varies within very wide limits. Some brewers do not exceed 5 lb. of sugar per barrel of 36 gallons; this quantity represents about 10 per cent. of malt. Others, however, use very much more, displacing as much as 30 or 40 per cent. of malt. In one instance we have found as much as 50 per cent. of the malt to be substituted by sugar. Beer No. 12 was brewed from produce of these proportions. Arsenical glucose, containing 0.04 per cent. of arsenious oxide, was used; the quantity of beer produced at the gravity stated by the brewer indicated that it contained the soluble matter of 3 lb. of sugar per gallon—equivalent to 2 gr. of arsenious oxide. From the table it will be seen that analysis only discovered about three-quarters of this quantity. It is extremely likely that the yeast is responsible for some of the deficiency as well as the brewing plant, which has certainly been found to contaminate subsequent brews made with arsenic-free ingredients.

Amount
glucose u
in inculpe
beers.

3631. You say as early as November 7th the brewer had this beer submitted to analysis, but nothing deleterious was found in it. Also, that other samples were sent for examination, and these were variously reported upon as severally containing 0.8 gr. (approximately) per gallon, 1.12 gr. per gallon, and 1.36 gr. per gallon?—I suppose the analyst had not had his attention specially directed to the possible presence of arsenic.

3632. Was it the brewer's own analyst?—It was an analyst whom they employed for the purpose.

3633. This was probably before the outbreak took place?—It was on November 7th—before the outbreak was known of in Manchester at all.

3634. (Sir William Church.) I suppose it was very likely sent to the public analyst of the district?—I think it was sent to a neighbouring town.

3635. It would be sent in the same manner as if a public analyst had to analyse it for adulteration?—Precisely.

3636. Not to look for poisonous contamination, but only for adulteration?—I think it was sent with a view to knowing whether there really was anything harmful in the beer; because this brewer had had complaints about the quality of his beer, and that it was doing an injury to the drinkers.

3637. (Chairman.) On the 7th of November some suspicion might have arisen as regards poison?—I should

Beer sus-
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Mr. Kirkby. think there was a suspicion in his mind when he sent the beer.

1st. 1901. 3638. As regards future safeguards, you agree, do you not, that it is most important to have something like uniformity in regard to analysis?—Most decidedly.

3639. Judging by the results of the analyses, you admit that there is considerable variety as regards the tests applied to the same sample of beer?—Not only with regard to the variety of tests, but with regard to the different methods in which different analysts manipulate the different tests.

3640. Before you can get complete security against poison you think the whole system of analysis should be uniform?—I think so.

3641. Numbers 18 and 19, you say, were brewed from all malt and hops, but were nevertheless contaminated with arsenic. You say, "very faintest trace" in each case: therefore when you say "contaminated with arsenic," were they contaminated to such an extent as by any possibility to be injurious to life?—Not being a medical man I would not like to give an opinion upon that: at the same time they were decidedly less than 1-100th of a grain per gallon.

3642. (Sir William Church.) Do you think that the analyst to whom this beer marked No. 12 was first sent ever examined it with a view to detecting arsenic?—I would not like to say. One does not know what method he followed in the examination of the beer. It would be presumptuous of me to say.

3643. It is rather important that we should know whether his attention was directed to it, and whether he did look for arsenic, or whether he only looked for substances which were known by former experience to be in beer, and might be prejudicial, such as *Cocculus Indicus* and other things which I should call adulterants rather than contaminations. I suppose you do not know what the terms of the reference to him were?—No. I think it was a sample of beer sent to him asking if there was anything deleterious in it. I have no means of knowing whether anyone at that time had any idea that arsenic was likely to be present in beer.

3644. If there was an idea that the beer had been poisoned by a servant one thing he would look for would be tartar emetic, would it not?—I should think so.

3645. So much depends upon the request made to him as to the nature of the analysis. It would be very disturbing to the public generally if a professional analyst had a sample of beer containing so much as this sent to him, and he said it contained none. But if he did not look for it it is a very different matter?—Exactly so. What was in the brewer's mind was that he knew the public were not drinking his beer. I do not know what the analyst was asked to look for.

3646. If he was asked to look for poisonous substances in the beer it seems to me that he was guilty of either a great mistake or great laxity in his examination. If he was not asked to look for poisonous substances in the beer he might have understood it only as seeing whether the beer was in a wholesome state.

3.4. (Chairman.) You have given us a long list of samples. Do you know how many of these used Bostock's sugar? Do you differentiate between those that were using Bostock's sugar and those that were not?—I can hand in a list of those that I do know were using Bostock's sugar. I know of my own knowledge that breweries A, B, and C and D used Bostock's. With regard to F, this firm does not admit to using any brewing sugar whatever.

3648. Have you found any arsenic in any beer or other materials which you have analysed which were obtained from people disconnected with Bostock's firm altogether?—I have no further knowledge than what I have just said on this point.

3649. Numbers 18 and 19, which were brewed from all malt and hops, would be excepted, would they not?—Yes. They were brewed in a brewery which previously used Bostock's sugar in the manufacture of their beers.

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3650. (Professor Thorpe.) I should like to ask you precisely what you mean when you say that, "To ascertain with anything like certainty the absence of arsenic from a complex organic liquid like beer by means of any of the usual tests is a matter of more than ordinary difficulty." What leads you to say that?—To take the beers I have examined: I found with Marsh's test that I could not say with any certainty that beer was free from arsenic.

3651. What do you exactly mean by the "usual tests"?—Marsh's test and Reinsch's test.

3652. But you may have to do certain preliminary operations with this "complex organic liquid" before you apply Marsh's or Reinsch's test to it?—Precisely so.

3653. Assuming that you have done that preliminary work, does it make it difficult to apply the Reinsch or the Marsh test?—To what preliminary operation do you refer in connection with the oxidation of the organic matter?

3654. The disturbing presence of preservatives?—First, with regard to the destruction of the organic matter, there is the danger of having arsenic in your acids, particularly sulphuric acid. I found very great difficulty in getting sulphuric acid free from arsenic. In the case of distilling the organic residue with hydrochloric acid there is a difficulty in getting the hydrochloric acid free from arsenic—that is with regard to getting the clean liquid to submit to Marsh's test. Again, I have found a difficulty, after the liquid has been put into the generator, in coming to a conclusion with regard to the deposit which I obtained in the Marsh-Berzelius tube. I find when I have zinc, which not uncommonly contains a large quantity of carbon, that there is sometimes a white film formed apparently of sulphur. When arsenic is present in a very minute quantity the formation of hydrogen sulphide, due to the slight reduction of sulphuric acid, causes the production of a yellow ring of arsenic sulphide instead of an arsenium mirror. These are a few of the difficulties that have occurred to me in connection with Marsh's test.

3655. Confining ourselves for the moment to beer, what is the particular difficulty in applying the ordinary methods of isolating the arsenic, say, by the agency of sulphuretted hydrogen in arsenicated beer in a form you can subsequently treat; where is the great chemical difficulty there?—The first trouble that presented itself to my mind was to operate upon a sufficient quantity of beer to get a weighable precipitate. I should hardly feel justified in attempting to weigh less than a milligramme of arsenium sulphide. Supposing the beer contained 1-20th of a grain per gallon, that would mean I should have to operate upon something like a quart of beer. After passing such a liquid as beer through all the operations necessary for the separation of that arsenium sulphide, I should have grave doubts in my mind as to the actual quantity separated, representing the original quantity of arsenic in the beer.

3656. Are these difficulties that you speak of what you yourself actually experienced, or are they set up from your inner consciousness, having set them aside in favour of Gutzeit's test, to which you eventually came?—Marsh's test is the one I have originally and always used for the examination of my sulphuric acids. In applying Marsh's test in the first instance in these beers I found very great difficulty indeed. In the first instance the test was applied to the beer itself, without any attempt to remove the organic matter, and that quite failed. With regard to the trouble with the zincs and acids, I have had an opportunity of examining a very large number; I do not know how many I have examined, but I shall be glad to give you the number should you so desire. I have only once come across zinc that is quite or almost quite arsenic free.

3657. What is the metal that you do actually now use for the generation of hydrogen in the Gutzeit test?—Zinc.

3658. You still use zinc and sulphuric acid?—Yes; but in the Gutzeit test the difficulty is got over in this way I have not to push everything to an extreme; I can eliminate the influence of the zinc and the acid by taking a given time for the reaction; that is to say, I know that a certain quantity of zinc with a certain quantity of acid in a certain time will give me a reaction due either to the acid or to the zinc. By reducing that to one-half I am able to eliminate the disturbing influence of the arsenic from the test.

3559. You mean that you are to that extent able to minimise the effect?—Yes.

3660. But surely you must know of other tests which get over your difficulties, which do not entail the use of sulphuric acid containing arsenic, or zinc containing arsenic, or any other materials containing arsenic, and which are available to you?—Yes; I may use aluminium or magnesium.

3661. But you know no methods which would enable you to get out the arsenic from the beer of a different

Mr.
Kirkby.
23 Mar. 1901.

Mr.
W. Kirkby.
26 Mar. 1901.

order from those you have mentioned, where the chemicals you use come under no suspicion of containing arsenic? I do not apprehend exactly what is in your mind in this preliminary statement of yours, where you say that it is a matter of more than ordinary difficulty to get arsenic free from a complex organic liquid?—The large amount of organic matter to be dealt with as compared with the small amount of arsenic is what is in my mind.

3662. What I mean is that of complex or organic liquids perhaps beer is one of the simplest. It is infinitely more simple than the contents of a stomach which occasionally one has to search for arsenic?—Perhaps I ought to have laid a little more stress upon the small arsenical content of the beer.

3663. The point is that you yourself have come to the conclusion that of all tests you know of the Gutzeit test, as modified by you, is the most satisfactory?—In my hands.

3664. I believe no one has had more experience with that test than you have?—I should not like to say that.

3665. Your name, I understand, is rather identified with the present application of that test, and you are connected in the contemporary literature with that test?—Yes.

3666. The one difficulty that appears to me connected with the application of the Gutzeit test is the fact that it is not essentially a quantitative method?—That is so.

3667. You try to make it a quantitative method?—I should not like to say that I have. It has been used as a quantitative method previously.

3668. But how do you, by the application of the tests, get the numbers you have given?—I have here a set of standard colours which I have obtained showing what one gets with various quantities of arsenic, which are stated, by using a given quantity of metal—zinc—a given quantity of acid, and operating for a given time.

3669. I think we ought to be quite clear about this. What you do practically in order to produce your standard tests is to introduce definite quantities of arsenious oxide, in this case a one-hundredth of a milligramme, in this case one two-hundredth, and in that case one three-hundredth of a milligramme?—Yes.

3670. That you introduce in what? In a definite quantity of liquid?—Yes.

3671. And in that particular apparatus?—Yes.

3672. With a definite amount of zinc?—Yes.

3673. And a definite volume of sulphuric acid?—Yes.

3674. And then you place on this tube a piece of paper moistened with a solution of the chloride of mercury?—Yes.

3675. And you expose the gas which comes away to the action of that paper for a definite length of time?—Yes.

3676. How long?—Previously, I exposed it for a given length of time—most of these were exposed for one hour. I may mention these quantities were not obtained with this apparatus; they were obtained with tubes. That was before I devised this method of passing the gas through these bulbs. Now, however, I have come to the conclusion that it is better, instead of fixing a given time for the gas to be evolved, to take a given quantity of zinc and quantity of sufficient used acid to dissolve the whole of the zinc. In this way I am quite sure of getting a given and a comparable amount of arseniuretted hydrogen passing through the bulbs. If I am operating upon a number of substances, and I am quite sure of having a uniform sample of zinc, I think a time exposure suffices; but I find that there is a very marked difference in the zinc one obtains in the market in the rate at which they evolve hydrogen when treated with dilute acids. At the present time, therefore, I think it is better to use a given weight of zinc, and submit that to the action of a given weight or volume of sulphuric acid, and allow the gas to pass through here (indicating) until it is dissolved.

3677. May I point out to you, what no doubt you already know, that the ease with which the zinc disengages its hydrogen stands in some connection with the amount of impurity it contains?—Precisely so. The purer it is the less rapid; that is my experience.

3678. Therefore, if you use very pure materials, the purest obtainable form of zinc and the purest obtain-

able form of sulphuric acid which you would wish to use, the ease with which you make your arseniuretted hydrogen within a limited time—because it is a limited time—the extent of the action would be very largely modified?—That was the point of my remark which I made just now, when I said I find it is better, in view of that fact, to take a given quantity of zinc and continue the action until the whole of the zinc is dissolved. In this way I get rid of the whole of that difficulty. If I take a given weight of zinc, I must get by means of that a given volume of hydrogen, however long the action is continued. I can quite confirm what you say, that the purest forms of zinc are extremely slow to begin the reaction, and also they are extremely slow to continue it.

3679. The point about that is that there is here an element of insensitiveness in your method, it seems to me, inasmuch as it has to be prolonged in order to get the end result over a comparatively long period of time?—I find even that with a very pure sample of zinc, 7 grammes will dissolve in $3\frac{1}{2}$ to 4 hours.

3680. You have to spend that amount of time before you get anything like an end result, the end result being only of a comparatively limited value, I venture to say with all submission, inasmuch as it is only a very approximate determination of the quantity, and rather tends, I think, to invalidate the test, or at all events is a disadvantage towards its general adoption, especially in view of the fact that you can get out the arsenic by other methods which do not involve the use of materials containing arsenic, and in which the end result can be obtained in a comparatively short time, and with a very much higher degree of quantitative accuracy?—That is so.

3681. You found it necessary to modify the original Gutzeit test?—Yes.

3681. And you found that on account of the disturbing influence of the sulphuretted hydrogen; is that not so?—Before I used this apparatus and before I tested the beers I removed the sulphurous acid by adding a small quantity of acid in order to dissociate any sulphurous acid that might be present in a fixed form, such as the meta bi-sulphites, and evaporating the liquid to a small quantity. I thus managed to get rid of nearly the whole of the sulphur compounds, the sulphurous action which might stain the paper. Now, however, I do not trouble to do that at all. I am able to put the beer into the apparatus and pass the gas through with the certainty that the whole of the sulphuretted hydrogen is removed in the bulbs.

2683. You place in these small bulbs a solution of the acetate of lead; then you bubble hydrogen through that, and you free that issuing hydrogen from sulphuretted hydrogen, and you hope that you do not rid it from the arseniuretted hydrogen?—I think I have to my own satisfaction settled the fact that arseniuretted hydrogen is not decomposed by passing through the lead acetate. Of course, the idea is not a novel one. I found when using Marsh's test that I could get rid of the action of the sulphuretted hydrogen upon the ring by passing the gas through the lead acetate. I have here some tubes containing arsenical mirrors; these were obtained by operating on the same quantity of arsenic; in one case the gas was passed through lead acetate solution, but in the other case it was not so treated.

3684. It is impossible to make any accurate detection of this; but what you mean is that the mirror is at least as intense as that, and that is all you can say?—Precisely so.

3685. Does it not strike you that for legal purposes, assuming that such a test as that is adopted, the very fact that it is only an approximation to a quantitative test, and that it is liable to be affected in the way I have indicated, that that rather invalidates the test for legal purposes in that it gives it an element of indefiniteness? No two persons would agree as to the exact amount of arsenic in the beer tested by that method?—I think if they were to carry out the instructions set forth in some official way there would be very little left to their judgment with regard to the colours obtainable in the end as to the presence of arsenic in the first instance. As far as my experience goes, I have had greater confidence in coming to a conclusion as to the amount of arsenic present as exhibited in the test papers than I have had from examining the mirrors seen in the Marsh-Berzelius tube, and greater confidence than I have had in examining the sublimate

Mr.
W. Kirkby.
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Mr. Kirkby. obtained from the copper in the Reinsch's test when the proportion has been small.

3686. I quite agree with what you say as to the indefiniteness of comparing mirrors in Marsh's apparatus as an index of quantity, but I venture to say that there are methods still open to us by which even in such small quantities with which we are concerned, the determination of the amount of arsenic may be made with a great degree of accuracy, either by the comparison of mirrors or by the comparison of tints, such as you have indicated?—Another difficulty that suggested itself to me in the carrying out of any test for the examination of arsenic was the quantity one has to obtain in order to carry out a gravimetric test. Of all the specimens submitted to me, I do not think any of them have exceeded a pint in volume.

3687. But there is no reason why in future you should be limited to such an amount as that is there?—No.

3688. If the public analyst demanded samples of beer he could readily obtain very much larger quantities than that, could he not?—Yes.

3689. (Chairman.) I believe it is a fact, is it not, that although some of the arsenical glucose appeared at first to be of different origin, further enquiries persistently made ultimately elicited the fact that the samples which came into our hands emanated from one firm only?—That is so.

3690. You are prepared to confirm that?—Yes.

3691. I believe you wish to tell us something of the possible introduction of arsenic into foods and drinks through the medium of sulphuric acid?—Yes. The possible presence of arsenic in sulphuric acid has been recognised by medical authorities, and is given expression to in the pharmacopoeias of this country for at least 50 years (A Translation of the Pharmacopoeia of the Royal College of Physicians of London, 1836, by R. Phillips, last edition, 1851, p. 9). Dr. Jonathan Pereira, in his "Elements of Materia Medica" (third edition, vol. 1, 1849, p. 356), stated that "oil of vitriol which has been manufactured from iron pyrites is frequently contaminated with arsenic, mostly as arsenious acid, but sometimes in part also as arsenic acid. . . . I have seen on the sides of the bottle containing arsenical sulphuric acid a deposit of crystallised arsenious acid." In the first edition of the British Pharmacopoeia (1864) and in each subsequent edition (1867, 1885, 1898) directions have been given for the testing of sulphuric acid to ensure its freedom from arsenic. That sulphuric acid may be the indirect means of poisoning by arsenic appears to be established by the prosecutions at the Marylebone Police Court, July 6th, 1900, for the presence of arsenic in effervescing sodium phosphate (Pharm. Journ. (4) XI. 51). In the evidence tendered in these two cases there was almost unanimity among the analysts that the arsenic had been introduced into the phosphate of soda in the course of manufacture from arsenical sulphuric acid. At that time I had an opportunity of examining sodium phosphate which contained half a grain of arsenium per lb., such samples as I have examined lately were arsenic free.

(Professor Thorpe.) It is quite conceivable in this particular case that the arsenic may have come from the phosphorus, is it not?—Yes.

3692. What direct evidence is there that it came from sulphuric acid?—I believe no evidence was tendered to that effect.

3693. I understood you to say that the evidence was in the particular case of the druggist that was tried?—The opinion expressed by the analyst on that occasion was in the direction of it having found access to the sodium phosphate through the sulphuric acid.

3694. It might equally have come from the phosphorus itself, might it not?—Yes.

3695. (Chairman.) You quote some cases of the quantity of arsenious acid from pyrites, and you mention a case which appeared in the "Lancet" where the sulphuric acid incriminated contained 1·4 per cent. to 2 per cent. of arsenious acid?—Those are Professor Dixon's figures, I think. I have never met with a sample of acid which contained so large a quantity of arsenic.

3696. You draw the conclusion that the variability of the arsenic contained is so great that the only consideration which would weigh with the purchaser, I presume, for security is the analysis of the particular batch of sulphuric acid he is buying?—Yes.

3697. You think it would be necessary to secure that it should not be tested in bulk, but that it should be tested according to each quantity as it is bought, small or great. Is that what you would urge?—Yes, and for this reason. Within the last year we had a batch of sul-

phuric acid. We are in the habit of testing each carboy for arsenic, and we found that half the carboys were markedly arsenical. Upon enquiry from the manufacturers we were informed that unfortunately their concentrating plant had broken down, and in order to fill our immediate requirements they had had recourse to a neighbouring manufacturer, asking him to send in a similar amount of acid, with the result that one-half of the batch was arsenical and the other half was practically non-arsenical.

3698. (Dr. Whitelegge.) Since when have you been in the habit of examining sulphuric acid for arsenic?—I cannot give you the exact number of years, but somewhere between 25 and 26 years.

3699. That is sulphuric acid to be used in the preparation of food substances, is it?—Mineral waters.

3700. (Professor Thorpe.) Was that sulphuric acid supplied under a guarantee of purity?—We had no guarantee except in so far as they knew that we must have it arsenic free. That is a matter of knowledge between ourselves. I can, but not for publication, give you the name of the firm with whom we deal. We were informed that in consequence of the price of the acid being diminished it was necessary that they should have recourse to using iron pyrites for the manufacture of their acid. Upon receiving that information we took the best means we could of protecting ourselves by not only asking them to send it de-arsenicated, but at the same time testing it ourselves.

3701. (Chairman.) I believe you have had an opportunity of examining a sample of barley. You say that you have found traces of arsenic in malt. I suppose you have succeeded in finding them yourself?—Yes. I had the opportunity of examining a sample of barley reaped in 1900. The seed was sown in chalk soil in April, and the land was treated the previous March with 2cwt. of raw bones and 2cwt. of superphosphate (arsenical) per acre. I did not succeed in obtaining the slightest indication of arsenic.

3702. Are you inclined to contend from that that it would not be dangerous to largely manure land with superphosphate or other artificial manures which are impregnated with arsenic?—I should not like to say that it was absolutely not dangerous, neither should I like to assert the contrary.

3703. But in this particular instance you found none?—None.

3704. What substances may arsenic be present in?—In addition to other substances, arsenic may be in acetic acid, phosphoric acid and phosphates, tartaric acid and the many articles into which it enters, such as baking powders, aniline dyes, which are not uncommonly used for colouring confectionery of various kinds, as well as cheap wines, purgative salts made from Epsom salts, sodium sulphate in pickles and sauces, and in caramel and similar substances. There would seem to be very great difficulty in the way of ensuring the absolute freedom of these various articles from some traces of arsenic.

3705. (Professor Thorpe.) Have you yourself analysed any of these substances?—Sodium sulphate I have found commonly contains small quantities of arsenic. It is chiefly obtained in the manufacture of mineral waters. The residual arsenic is left in the sodium sulphate which is taken from the generators. I have also found arsenic in caramel. I should like an opportunity in the future to speak of some other substances, particularly caramel, as I have one sample in particular in mind which contained a fair quantity of arsenic, but not nearly so great as in the glucose which I have examined.

3706. Have you found arsenic in baking powders?—No.

3707. In artificially made Epsom salts?—I have not.

3709. Have you found it in any pickles or sauces?—No, I have not.

3709. (Chairman.) You indicate here a possibility of a danger rather than a danger which you have yourself proved?—That is so.

3710. You think a danger really lurks in the consumption or use of these articles which may enter into food?—Yes.

3711. I suppose you wish us to understand, to sum up your evidence, that you think most constant and careful analyses of sulphuric acid are the only protection as regards the consumer, whether of beer or articles of food?—From my own experience I think that it is absolutely necessary.

Mr. W. Kirkby.
25 Mar. 1901

Precautions in obtaining acid for mineral water manufacture

No arsenic found in barley grown on arsenical soil.

Chemical substances liable to contain arsenic.

Arsenic in sodium sulphate and caramel.

Mr.
W. Kirkby.
25 Mar. 1901.

System of
testing
sulphuric
acid at
Messrs.
Jewsbury
and Brown's.

3712. What degree of purity of sulphuric acid do you think is suitable for the manufacture of foods and drinks?—At Messrs. Jewsbury and Brown's works large quantities of sulphuric acid are used for the production of carbonic acid gas (CO_2) for the aeration of the mineral waters. Between 20 and 30 years ago the practice of testing every carboy of sulphuric acid for arsenic was adopted because of the increasing use of pyrites in its manufacture. Although only de-arsenicated sulphuric acid is bought, it is necessary to rigorously persevere in the testing because of the liability to accidents, such as, for instance, the breakdown of the acid maker's plant. It should be pointed out that in the use of the sulphuric acid for the production of the carbonic acid gas the acid itself does not enter into the composition of the mineral waters, neither can any of its non-gaseous impurities do so. Notwithstanding this fact, in order to guard against likely and unlikely accidents, we prefer to have no poisonous article on the premises. In order to give an idea of the amount of control which this system of testing ensures, I have compiled a table of our records for the last four years, and taken two other years at four year intervals. This table expresses in percentages the amount of acid rejected on account of its arsenical content. For obvious trade reasons the actual quantities bought and rejected are not given:—

TABLE.—Proportion of Sulphuric Acid rejected on account of its Arsenical content.

Year.	Rejected per cent.	Remarks.
1888	0.46	
1892	Nil	
1896	"	
1897	"	
1898	"	
1899	0.15	
1900	0.88	Half of this quantity was in one batch, the batch I have referred to.

The sulphuric acid which is used in this process is not absolutely arsenic free; such an article is almost, if not quite, unobtainable; but we do succeed in obtaining at a reasonable price an acid containing from one part in $1\frac{1}{2}$ millions (1,500,000) to one part in 2 millions (2,000,000); occasionally we obtain it containing as little as one-tenth of this proportion. I may say that it is extremely pure acid which we only rarely come across.

3713. (Professor Thorpe.) Do Messrs. Jewsbury and Brown contemplate using liquid carbonic acid?—They have had the matter under consideration.

3714. What is the difficulty?—The difficulty is one of cost.

3715. Is it cheaper to make your carbonic acid for the aeration of your waters still from carbonate of lime or soda?—It is cheaper to make it from carbonate of soda.

3716. Are there any brewers in the neighbourhood making liquid carbonic acid?—I do not know of any. In Manchester we have a depôt of the Lea Bridge works which supplies large quantities, I believe, to the local manufacturers.

3717. You have no experience yourself of the use of liquid carbonic acid?—We use it in special circumstances.

3718. You say the cost is prohibitive at present?—It is simply a trade matter. We simply use it for convenience with certain machines.

3719. Anyhow, in future one way of getting rid of arsenic would be to use natural liquid carbonic acid?—I do not see any possibility of arsenic getting into liquid carbonic acid gas.

3720. You would avoid the use of arsenicated sulphuric acid in your works?—Yes, precisely.

EIGHTH DAY

AT THE TOWN HALL, MANCHESTER.

Tuesday, 26th March, 1901.

PRESENT:

Sir WILLIAM CHURCH (in the Chair).

Professor THORPE.

Dr. WHITELEGGE.

Dr. BUCHANAN, Secretary.

Dr. J. DIXON MANN, called; and Examined.

Dr.
J. D. Mann.
26 Mar. 1901.

3721. (Chairman.) I believe you are Professor of Medical Jurisprudence and Toxicology at Owens College?—I am.

3722. During the recent epidemic you saw a number of cases in both in-patients and out-patients in the Salford Hospital?—I did. Might I add this—it will facilitate matters with regard to the clinical aspect—that I am physician of the Salford Royal Hospital, which gives me a good opportunity of seeing those cases.

3723. I believe you also saw cases in private practice?—Yes, in consultation.

3724. Many?—No. I would not like to say many—several.

3725. As compared with the hospital cases, were they severe?—Yes, they were, because being seen in consultation they were necessarily severe. As a rule I saw them at their own houses, not at my rooms.

3726. And they presented the same symptoms?—Yes, they practically presented the same symptoms; that is to say, they were varied. In one or two of the private

cases they were rather anomalous, as it happened, but that is a mere accident.

3727. I suppose they were the neuritic symptoms for which you were called in consultation chiefly?—In two or three instances. In the others it was on account of the anomalous nature of the case, the doctor not being able to diagnose what it was.

3728. Were the private cases pigmented in the same way as so many of the hospital patients were?—No. My fortune has been rather curious in respect to the common pigmentation. Although Salford is a centre where one of the large breweries to which is attributed a good deal of this beer is situated, and where a large number of the people drank this beer, the cases of pigmentation in the Salford Hospital, according to my experience, were exceedingly few in proportion to the total number of cases.

3729. Were the gastro-intestinal symptoms marked?—In a few instances. In one private case, for instance, where the man had for a week before being laid up symptoms of acute arsenical poisoning, vomiting, and purging. He got better from that, and afterwards

Dr. Mann. developed one of the most severe acute attacks of neuritis I have seen.

Dr. Mann. 1901. 3730. Had you any doubt in your own mind that these cases were due to arsenical poisoning?—Not the least.

3731. What evidence did you get of the presence of arsenic in these patients during life?—There are what I term the immediate channels of elimination, the urine and the faeces, and then the secondary channels, the skin and its appendages. First of all with regard to the urine, I found arsenic present in the urine in all the recent suspected cases that I had to do with. Arsenic was found in the urine 21 days, in another case 32 days, and the longest period in which I found it was 59 days after the patient had ceased drinking beer. That was from 40 ounces of urine; but I look upon it as rather exceptional. I had found arsenic in this case before, and I was purposely leaving it for a very long time in order to see how long I could find it. I may say, in order to prevent any misunderstanding, that the cases that I quote as regards the urine, are cases that I had under my own care in the hospital wards, and, consequently, that is the minimum time; of course patients would probably say that they did not take beer for so long before, but I do not reckon that in. I reckon it from the day of admission into the hospital, when they could not have had any beer.

3732. I thought it might have exceeded that?—Yes, it is quite possible, by an unknown time; but I do not attach any importance to that, because everybody knows the unreliability of evidence of people given in matters of this kind.

3733. With regard to the amount, was it traceable or appreciable?—Very appreciable. In fact, if one had gone to the trouble, and had taken, say, a couple of litres, one could have got a weighable amount. In many of the cases, of course, it depended a great deal upon how long the patient had been abstaining from beer. I got a lot from the out-patients, for instance. There I had to take their word for it, and many of them frankly avowed that they had been taking beer up to that day, and in those cases one found an enormously, if I may use the term, large quantity. There was no difficulty at all. Reinsch's test in a very few minutes brought down a copious deposit on the copper, from which I obtained a large crop of crystals.

3734. You mentioned faeces. Will you tell us your experience with regard to that?—I have examined the faeces frequently for experimental purposes before this epidemic, but I have not examined them in this epidemic, because I knew exactly what occurred, and it is rather a disagreeable and troublesome process. Some 10 or 12 years ago I made a number of experimental observations both on the faeces and urine in people who were taking arsenic, and I found that one could detect it very easily. For example, in a patient whose urine and faeces showed no arsenic, as proved by analysis, on giving five drops of liquor arsenicalis equal to one-twentieth of a grain of arsenious oxide, half-an-hour afterwards arsenic was easily detected by Reinsch's test in the urine, and also in the first subsequent motion. I have proved this several times, so it was unnecessary to do it again. I assumed that the arsenic was being eliminated by the bowels as well as the urine.

3735. (Dr. Whitelegg.) Where were those observations published?—I quote the fact in my book, but I have not published it separately, because it was a pretty well-known thing. It was merely refining it down. It was known that arsenic would pass by the urine pretty quickly, and I did it simply as a proof test. Perhaps I may presently come back to the point. I next took some of the horny scales that you find on the feet in keratosis, which is very common, as you are aware, in chronic arsenical poisoning. I must confess that I was astounded with the amount of arsenic which was present in the horny scales, and also in the other skin appendages, the hair, and particularly the nails. I jotted down a few notes that I made in a number of cases. For instance, I got ample evidence of the presence of arsenic from 0.2 gramme of the horny scales, and 0.1 gramme of the horny scales, and even from 0.03 gramme, that is three centigrammes of the horny scales. I imagined I might find it with difficulty, but in fact I obtained well-marked crystals without any difficulty whatever. Further, it is of interest to note that some of the arsenic present in these scales is, to a certain extent, soluble in water, for on boiling one-tenth of a gramme of the scales for about three minutes in 20 or so cubic centimetres or distilled water,

and then filtering through very close filter paper so as to keep back any particles, I got evidence of arsenic both from the filtrate and from the solid matter. I did this several times. Then, in two instances, I obtained arsenic from the sweat. Unfortunately there were not many opportunities of making experiments, because hyperidrosis is one of the early symptoms, and I had difficulty in obtaining enough fluid to enable me to make an examination. The next point is the nails. I was more surprised than ever with the amount of arsenic that was present. For instance, I obtained from one-tenth of a gramme, five centigrammes, eight centigrammes, six centigrammes, and three centigrammes, of the nails, in each instance, arsenic crystals without any difficulty. It was quite obvious that there must have been a large percentage present. Some of these cases had gone on for a long time, but I had to take the patient's word for it. With regard to some of them I felt fairly satisfied that they were telling me the truth, but with regard to others I had doubts. In one case I got arsenic out of five centigrammes of nail cuttings from an out-patient, a man, who said he had had no beer for four months. I was disposed to believe him, because he had been in the Union Hospital as a patient for neuritis, and would not have had any opportunity of getting beer. I also examined some of his urine when he came in, and I found no arsenic. If he had been taking beer more recently I should have found it in the urine.

3736. I suppose when the arsenic gets into the epithelial structures it would be likely to remain there until they were shed, because it is extra vascular?—Yes; it is outside the system entirely.

3737. Once there it would remain there until in the process of time the epithelial layers were worn off?—Yes; whereas any arsenic that is present in the urine is directly derived from the body. In amounts of hair varying from a gramme to half a gramme, three-tenths of a gramme and even in two-tenths of a gramme, I found arsenic. These investigations in several ways are interesting. In one or two cases I found arsenic present in the hair, and in the nails, and there was absolutely no symptom, and had been none. In the surgical wards, for instance, there was one case of a woman admitted for a fractured leg. One of my colleagues knew that I was investigating these matters, and he said, "There looks a likely subject for you upstairs," so I went into the ward; but the woman denied having had any symptoms whatever, any tingling or numbness. There was no pigmentation nor keratosis; absolutely no symptoms. She was simply in the hospital for a surgical accident. She was an obvious alcoholic, with a large liver, so I got the sister of the ward to cut some hair off and clip the nails, and in both of these I found arsenic in the usual quantities. That is not a solitary case; so that you may have arsenic taken in beer without producing any apparent symptoms in certain cases. I was particularly struck with the affinity of these keratin tissues, the horny layer of the epithelium, the hair, and the nails for arsenic, and the large amount that they would take up. I turned it over in my mind whether any deduction could be drawn from that, and I thought of the neuro-keratin which is in the nerve structures, in the sheath of the nerves, and also in the brain. Neuro-keratin has such a very close chemical relationship to ordinary keratin that I thought it was possible it might have the same affinity for arsenic that the keratin itself undoubtedly possesses. I believe that although Gautier and many other observers have said that arsenic has been found in skin, nails, and hair, no one has pointed out, as far as I know, the extraordinary affinity that exists between the keratin tissues and arsenic. This seemed to me to offer a possible explanation of the nerve symptoms. I had not the opportunity until quite recently of carrying out an experiment that I wished to make, but recently I have done so; but I have not finished the investigation, so I should like what I say to be taken as a provisional inference, and not as a decisive conclusion. Physiological chemists have found that neuro-keratin exists in the white matter of the brain in about ten times the amount that it does in the grey matter, that is to say, in the grey matter you get 0.3 per cent. and in the white matter you get, according to some observers, fully 3, and according to other observers, just under 3 per cent., so that it is just ten times the amount of the other. It struck me that if I took a brain, and separated the grey matter from the white, and analysed equal weights of each, I might possibly get some evi-

Dr. J. D. Mann. 26 Mar. 1901.

Arsenic in hair of alcoholic patient without symptoms of arsenical poisoning.

Affinity of keratin tissues for arsenic.

Arsenic in grey and white matter of brain.

Dr.
A. D. Mann.
13 Mar. 1901.

dence as to whether the neuro-keratin did take up the arsenic. Dr. Reynolds was good enough to furnish me with a brain of one of his cases in which a post mortem had been made for arsenical poisoning. I first of all divided it longitudinally as nearly as possible into halves. In one half I separated the grey from the white matter. Of course, it was impossible to do so absolutely. I got two heaps; one consisted chiefly of white, and the other of grey matter; that is as much as I could say. I took 240 grammes of each; the other half of the brain weighed 660 grammes, and it was dealt with just as it was, without any separation. From the grey substance of 240 grammes I got an unweighable quantity of arsenic. From the equal amount of 240 grammes of the white matter I got the equivalent of 1.80th of a grain of arsenious oxide, and from the complete half I got about 1.30th of a grain of arsenious oxide.

3738. (Chairman.) Have you taken any of the peripheral nerves and tried them?—No, I had no opportunity. Of course I am at the mercy of the post-mortem makers, and I have had to make special appeals to get what I have had.

3739. You speak of other means of extraction. Besides the urine, scales, excretion and sweat, you have mentioned the hair and the nails. Are there any others?—Those are all the sources of elimination that I have investigated in the living.

3740. You did not make any experiment upon the mucus from the lung?—No. There are plenty of cases where you have bronchitis associated with arsenical symptoms, and I might have got some mucus, but I did not think of it.

Arsenic in
hair.

3741. (Dr. Whitelegge.) In cases of long hair would you expect to find arsenic some years after?—I am doubtful about that. There might be. With regard to the elimination of arsenic I should say that as regards urine the elimination begins very quickly, very promptly, and, as far as I know, is continuous under ordinary circumstances, so that arsenic is not stored up in the system as some of the heavy metals like lead and copper are. The tendency seems to me, from what I have observed in this outbreak, to be that the arsenic in a comparatively limited time all gets away excepting very small traces, which may be found post mortem. Therefore, the hair, I take it, would become free in time. I got arsenic from some hair from an out-patient, who said that he had not had any beer for five months, but I should imagine that in six or eight months most of the arsenic would have gone away.

3742. Gone away in the sense of having gone into the hair?—Yes, it would probably have gone into the hair.

3743. I am speaking of the case of long hair?—That depends upon the length of time. You would find it at the extreme end, if the hair was very long. If it was not cut you would find it for an indefinite time. If it was once there, and if it came away, it would be simply by attrition. I suppose that if you cut the hair off it would retain the arsenic for an indefinite time, in the same way as you can keep arsenic in a bottle.

3744. In the case of long-haired women you would find traces of old arsenical poisoning?—Undoubtedly.

Difference
between
chronic and
acute
arsenical
poisoning.
Cumulative
effect greater
in the former.

3745. But no time-equation has been attempted in that way?—Not that I know of. In England chronic arsenical poisoning as in the present outbreak is quite a new matter. A great distinction must be drawn between cases of acute arsenical poisoning which were previously known in this country and these cases of chronic arsenical poisoning; for example, in the acute arsenical poisoning you will not find arsenic in the urine longer than 10, 12, or 14 days at the outside. I have never found it in acute cases longer than five or six days. It seems to me that the constant taking of small doses causes the arsenic to back up, if I may use the expression, in the tissues. I do not think that it combines in the sense that the other metals do, but more is received than can be eliminated. A certain amount is stored up, and it takes time to come away. The general tendency is for the arsenic to get away, judging from the cases I have followed so far, in six or more months probably, but something like that. That is a rough guess. I should like to point out to the Commission there is a very thick line to be drawn between acute arsenical poisoning and chronic arsenical poisoning, so far as the elimination goes. We have always regarded arsenic as a non-cumulative poison up to now. Cumulative is a relative term, but arsenic lingers in the system much longer than we thought.

3746. If the question should arise whether three or four years ago there was arsenical poisoning unnoticed going on in Manchester or anywhere else, it would be conceivable, would it not, that some trace of it might be found in the case of long hair?—Yes; only I think probably the hair would be cut at intervals during that long period, and the traces of arsenical poisoning might disappear. In one case I made an experiment on a woman in whom I had watched the arsenic being gradually eliminated and disappearing. I took as much as I could off the tips of the long back hairs, and I also took some close up to the scalp. In the long hair at the back I found arsenic easily, but in the other I could not quite satisfy myself whether there was any arsenic or not. It had just got to about vanishing point.

3747. (Chairman.) Did you by any chance make any experiments with hair from different parts of the body?—I did not.

3748. Pigmentation is particularly marked on certain parts of the body, and the pubic hair particularly might contain a larger quantity than hair from the head, as pigmentation is more marked on the pubes than on the head?—It is quite possible; but I have made no observations in that direction. The hair I obtained was exclusively from the head.

3749. Did you make any control observations when giving patients arsenic medicinally?—Yes; I did that long before this epidemic.

3750. You have already told us that in your cases pigmentation was not a marked feature?—That was so.

Cases
without
rigo-
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3751. And you have also told us that the peripheral neuritis was well marked in many cases in which there was no exceptional pigmentation?—Quite so.

3752. I think you noticed something in connection with the condition of the heart in those patients?—Yes; there was a very marked tendency to rapid cardiac dilatation, such as we usually associate with alcohol. It is a very difficult matter to draw the line, seeing that the arsenic was in alcohol. At first I approached the question with the impression that the cardiac symptoms would be due to alcohol, but I gradually came to the conclusion that the arsenic had a very great deal to do with it. After listening to the evidence at the inquests, and in attending my own cases at the hospital, and hearing of others which were reported to me by medical men, I have come to the conclusion that in the great majority of cases death was due to cardiac failure. There were other associated symptoms, such as bronchitis and enlarged liver, which might be due to the cardiac dilatation.

Cardiac
sympt

3753. Which side of the heart was especially dilated?—The left side—the left ventricle. This came on with exceeding rapidity in some cases. The patient would have a normal temperature and present normal appearances very frequently, with some intercurrent condition, such as bronchitis or broncho pneumonia, and would be going on pretty much as usual, when suddenly in a few hours the temperature would drop to sub-normal, and the patient would evidently be in a state of absolute collapse. You could not find any apex beat; the area of cardiac dullness would be very much enlarged, and the patient would rapidly sink, the heart never recovering. I saw several deaths of that kind. I was very much impressed with the effect that the arsenic seemed to produce upon the heart muscle. I may say that in the analyses I made I found, as would be expected, a very large amount of fat both in the liver and the other organs. Of course, one associates that with alcohol. The organs had undergone a considerable amount of fatty change. This possibly may have had to do partly with the rapid cardiac dilatation. On the other hand there is the question of the innervation of the heart, the nerve supply to consider. From the suddenness of the occurrence, I think it is more likely to be due principally to some interference with the nerve supply caused by neuritis, the same as you have in peripheral neuritis.

Death
heart
failure

3754. That we are acquainted with. It takes place in other forms of neuritis—diphtheritic neuritis, for instance—does it not?—Quite so. It is analogous to that. In diphtheritic sometimes you get absolutely sudden death; whereas in these cases they were sudden in the sense that the patient being in a fairly favourable condition, considering the disease, until a given day, when within six, eight, ten, or more hours the patient would die in a state of collapse. If you saw the patient during that time you would find evidence of rapid cardiac dilatation.

Dr. J. D. Mann. 3755. In those cases of rapid cardiac dilatation had the muscular fibres undergone fatty degeneration, or did you find rather that the heart was in a state of fatty infiltration?—I cannot say that I went into that. That is rather histological. I did not examine microscopically. I had not the time.

3756. You would say, would you not, that the heart of many habitual exceders in alcohol is in a state rather of fatty infiltration than of fatty degeneration?—Quite so.

3757. This would, if it was due to fatty degeneration of the heart, degeneration of the muscular tissue, itself point a little to its being due to something in alcohol?—Quite so; I am not speaking of that, merely that there was a large quantity of fat present.

3758. In those cases in which death appeared to be due primarily from the heart, did you notice the condition of the diaphragm?—Yes, in two instances. In one case of my own in the hospital the diaphragm was paralysed for fully a week before death, and the respiration was all costal.

3759. That you would attribute, of course, to the condition of the nerves rather than to the muscular tissues?—Yes. I trust I made myself clear with regard to the heart. I put the fatty change in a secondary position, although I mentioned it first. The interference with innervation I think is the more important cause.

3760. (Dr. Whitelegge.) Do you attribute that to the arsenic?—I do. I must repeat that it is very difficult to distinguish between some of the effects of arsenic and of alcohol. We have found the same thing with alcohol, so that it would not be proper for me to make a very decided statement. I should not be justified in doing so.

3761. Have you found anything parallel in your observations with regard to the action of arsenic on the heart?—I should like to make it clear to the Commission that our knowledge of chronic arsenical poisoning before this epidemic has been practically nil. I take it that the most experienced of us have only seen the fringes of it—those few cases which have occurred through the over-administration of medicine, through idiosyncrasy, or some of those cases where people have been poisoned by wall-paper, and so forth. It has been a very exceptional thing. Most of our knowledge of arsenical poisoning in England up to the present time has been of acute cases.

3762. In those cases has there been anything to observe to suggest this particular complication?—I had not observed it myself. I had no experience to go upon in the matter before this epidemic. I should not like to express an opinion upon it.

3763. (Chairman.) Without expressing an opinion, they were very anomalous symptoms, were they not, which were observed in connection with arsenical poisoning from wall-papers?—Yes; but it so happens that I have never personally had to investigate any of those cases.

3764. And neuritis occurred?—Yes; I have read of symptoms of neuritis occurring.

3765. And extreme feebleness of the pulse has been noticed in connection with it?—Possibly; but I cannot speak as to that.

3766. Do you think that it is likely that we have for long confounded and called the condition alcoholic neuritis which might really be due to unrecognised arsenical poisoning?—It is a very difficult question to answer. I believe still that there is such a thing as alcoholic neuritis, but I may say I have latterly been disposed to think it quite possible that there have been small quantities of arsenic in the beer—I say quite possible, I do not go beyond that—which would account for some of the neuritis we have had in these parts before this epidemic. It was a fairly common thing in hospital work to have cases of neuritis before this epidemic. Of course, one put it down to alcohol, all these people being drinkers, but since this epidemic I have had my doubts as to whether arsenic may not have had something to do with it. I say that, of course, without at all ignoring alcoholic neuritis, which I firmly believe in.

3767. It seems to have been very much more common in this district, in Manchester and Liverpool, than it is in London and the southern large towns?—So I believe. I have heard your own experience at St. Bartholomew's.

3768. You cannot say anything of your own knowledge with regard to that?—I cannot.

3769. (Dr. Whitelegge.) Do you associate alcoholic neuritis with beer or spirit drinkers?—I am entirely relying for my evidence upon spirit drinkers, because if the people took beer there might be arsenic in it. You assume, however, that there is not arsenic in alcohol—that is to say, in spirit. On going over the evidence very carefully, I have found several cases in which the patient took spirits exclusively, and suffered from neuritis.

3770. (Professor Thorpe.) Was that in Manchester?—Yes.

3771. (Chairman.) You are aware, no doubt, that when the so-called alcoholic neuritis was first discovered, or, at all events, first described by Sir Samuel Wilkes, that he thought he was dealing with spirit drinkers?—Quite so; that was my first impression. When I first came across alcoholic neuritis I thought it could not be produced by beer, that there was not enough alcohol present. I think that was the impression of almost all of us at first.

3772. Have you seen any recent cases of alcoholic neuritis among persons who apparently have not drunk suspected beer?—I have recently seen a case of alcoholic neuritis in which the person drank no beer at all. This was an elderly lady, whose husband told me, and I know from internal evidence that there was no reason to deceive, that she had only drunk whisky, as beer did not agree with her. She had had no beer for 14 or 15 years, but she had undoubted neuritis. That is one of the cases which makes me feel satisfied that there is such a thing as alcoholic neuritis.

3773. Under what heads would fatal cases be likely to be returned in death certificates?—As alcoholism particularly.

3774. I believe alcoholic neuritis is a term which has not been used by the Registrar-General; it has all gone under the head of alcoholism, has it not?—I have not looked into the reports.

3775. Then you would not like to give us an opinion as to how long the profession generally has recognised alcoholic neuritis to put it on death certificates?—As to absolutely putting it on death certificates, I could not say from my own knowledge, but from my acquaintance with professional opinion, for a long time—a dozen or more years—we have looked upon alcoholic neuritis as an ordinary complaint—that is to say, as a complaint which occurred with a certain degree of frequency.

3776. Do you say that for more than a dozen years it has been in the nomenclature of disease?—We have associated this condition with alcohol more closely perhaps than has been the case further south. The late Dr. Ross was one of the medical men here who gave a great deal of time to the question and wrote a good deal about it, and in that way the profession in the neighbourhood got acquainted with it early on, so to speak. But I cannot speak to the actual form of the certificates.

3777. Do you know any instance where arsenical poisoning through beer seems to have accelerated death without causing distinct neuritic symptoms?—Yes, I have known several cases in which there was some dormant, at least some chronic malignant disease, in which the patients died unexpectedly, and in which there were no arsenical symptoms. I have found arsenic during life from some of the excretions in these cases, and I have found it in the viscera after death. My impression was that, although the malignant disease was the main cause of death, death was undoubtedly accelerated by the arsenic, and there is equally no doubt that death has been accelerated in acute cases of bronchitis and pulmonary trouble generally, as, of course, you would easily perceive from the heart.

3778. (Dr. Whitelegge.) Would arsenic be mentioned on the death certificate in such a case?—No; that would involve an inquest.

3779. (Chairman.) Do you think it had a prejudicial effect on the cases in connection with malignant disease?—I think so, from the mode in which they died. They collapsed in an unexpected way as compared with ordinary cases of malignant disease. Oddly enough, in other cases there is an increase in the temperature which is not common in abdominal malignant disease.

3780. On the other hand, arsenic has been supposed in some forms of, say, new growth, rather than malignant disease, to hold it in check?—That is so.

3781. So that those cases ought to have improved?—They ought to, but, unfortunately, they did not. That was also a striking thing as regards the anomalous

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Alcoholic neuritis in a non-beer drinker.

Death from other causes accelerated by arsenic poisoning.

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Febrile
attacks
resembling
enteric fever
in some
cases.

Arsenic in
viscera of
fatal cases at
Manchester.

poisoning. I have seen cases where there were no symptoms of neuritis, no pigmentation, but there was a rise in the temperature, and the patient had a kind of febrile attack. There was the presence of arsenic in the excretions, and there was no recognisable disease. The condition was mistaken sometimes for enterica, but there were no enteric symptoms. The patients continued for a fortnight or three weeks with an elevated temperature, and then slowly recovered—very slowly. Similar cases, I believe, have been recorded at Hyères during the epidemic.

3782. Did you examine any of the viscera in these fatal cases?—Yes, I examined parts of the viscera from 11 cases, but in one or two of them there were only parts, such as brain and bones. That was for scientific purposes. I have examined six bodies for the coroners of Manchester and Salford.

3783. Will you give us the results?—The first two cases I am going to mention are valuable because the patients died in the Crumpsall Hospital, and therefore they were under observation for a time. One case was that of a woman aged 40. She was admitted in the Crumpsall Hospital on October 30th, 1900, and died on November 22nd. She was, therefore, in the hospital for 23 days. In that body, neither in the liver, kidneys, or spleen, nor in about eight fluid ounces of liquid from the abdominal cavity—she had ascites—did I find any arsenic. That result was corroborated by Dr. Stevenson, whose evidence you have already had, and who had the corresponding half of the viscera. The next case was that of a woman whose age I do not know, though it can be ascertained, as it was one of the Manchester Coroner's cases. She was admitted on the 2nd October, 1900, and died on the 23rd November. She was, therefore, in the hospital for 52 days, obviously without beer. I asked Major Valentine whether there was any chance of her getting beer, but he scouted the idea, and said that, of course, there was no chance of her getting any. In that case I found arsenic present in 16½oz. of liver, but not in a weighable quantity. In 4½oz. of kidney I also found arsenic present, but not in a weighable quantity. In 2½oz. of spleen I found a trace of arsenic. With the exception of another case, one of my own, these are the only two cases I can vouch for as to the length of time which elapsed since their taking beer before death. The others are outside cases—coroners' cases—in which the evidence given is probably untrustworthy. The next case was that of a woman aged 38, who died on December 2nd. In 31½oz. of liver arsenic was present, but unweighable. In 2½oz. of kidney arsenic was present, but unweighable. In 3½oz. of spleen there was an obvious trace. In 6½oz. of heart there was a trace; and in 3½oz. of lung a faint trace. The next case was that of a woman whose age I do not know. It was a coroner's case, and the age could therefore be obtained. She died on December 24th. In 19½oz. of liver arsenic was present, but unweighable; in 3½oz. of kidney arsenic was present, but unweighable; and in 2½oz. of spleen arsenic was present, but unweighable. I may say that all these cases were women with one exception. I have only examined one male case out of all this number. The next case died on November 27th. Unfortunately but a small amount of the viscera was sent, and I had to divide it with Dr. Stevenson. I only got 8oz. of liver, but in that 8oz. of liver I found a weighable quantity of arsenic, over 2.10 of a milligramme. Reckoning the size of the liver, that would make 1.30th of a grain of arsenious oxide in the whole organ. Dr. Stevenson practically came to the same conclusion. In 1½oz. of kidney there was an unweighable quantity; in 2oz. of spleen there was also an unweighable quantity; and in 1½oz. of brain there was barely a trace. I would not like to say there was not any—there was just a little deposit. The next case was also that of a woman, who died on the 11th December. I do not know her age. In 20oz. of liver there was 8.10 of a milligramme of arsenic, equal to about 1.25th of a grain of arsenious oxide for the whole organ. In 3½oz. of kidney there was an unweighable amount; in 1½oz. of spleen there was also an unweighable amount; and in 2oz. of stomach there was just a faint trace. These are cases which I have investigated for my own information. The other case was that of a male who died in February. I do not know the date of the death, nor do I know the age. In this case there was in the liver an amount equal to 1.18th of a grain of arsenious oxide. The kidney and the spleen I have not yet examined, as I have not had time. I examined the bodies of the vertebrae. I had 100 grammes of liver, and I found arsenic in an

unweighable amount. In 75 grammes of brain I found a mere trace. Then there is a case which is of some interest—it was my own case in the hospital. During life I found arsenic present in the hair, but not in the nails. There was no keratosis, but I found arsenic in the extreme ends of the hair, though I found scarcely any in hair taken from close to the head. After death we got all the organs to make a complete examination, so that this case is interesting from a scientific standpoint. I found in the liver, which weighed 1,012 grammes, simply an appreciable, but an unweighable amount. In the kidney, which weighed 157 grammes, I found a trace; in the spleen, which weighed 72 grammes, I found a slight trace; in the brain, which weighed 1,184 grammes, an obvious trace; in the bodies of the vertebrae, which weighed 130 grammes, I found an obvious trace, very comparable with that obtained from the whole of the brain. I had the thyroid very carefully taken out and freed from everything else. It weighed 15 grammes. In that I only found a faint trace of arsenic, such as I should expect to find from a similar weight of muscle. You will understand the point of that. Finally, there was one other case in which I examined 7½ozs. of viscera, liver, kidney, and spleen, sent to me by the coroner. I had to analyse them together, and I found equal to ½ milligramme of arsenious oxide. In one more case I examined the vertebrae. I have some more bones, which I am working at still. In 200 grammes of the bodies of the vertebrae there was an appreciable but unweighable amount. That is rather important scientifically. I might also mention, as interesting from a medicinal standpoint, that the bodies of the vertebrae when I saw them down before breaking them up into small pieces exhibited an extraordinary amount of red marrow, such as I have never before seen. There was the same appearance in the bones of the skull.

3784. Have you made any examination of the blood?—No; I have not had any blood.

3785. You do not know whether there has been a large quantity of myeloid cells?—I cannot say; but that would point to the influence of arsenic in anaemia and dysentery.

3786. The result of all these examinations of what we may call chronic cases is that you have been able to find in the viscera very much smaller quantities than you would expect to find in fatal cases of acute arsenical poisoning?—Undoubtedly.

3787. Have you any knowledge of detecting arsenic in bodies in whom there has been no suspicion of the ingestion of arsenic?—Not in the bodies. I found it unfortunately too late, in one case, in a very early part of the epidemic, where I got some keratosis.

3788. I am not speaking of the epidemic alone, but whether you have found in the course of your toxicological experience arsenic frequently or ever present in the viscera where there has been no likelihood of arsenic having been ingested?—I cannot say that I have ever examined for it.

3789. It has been stated that arsenic is a normal constituent of the tissue?—You are alluding to Gautier. I entirely disagree with that. I believe it was introduced adventitiously, and that it is not a normal physiological constituent of the body. You might just as well say that copper is, and with some reason, for I have never examined the viscera of a body, particularly the feces of a presumably healthy person, without finding traces of copper; yet copper is not a physiological constituent of the body.

3790. Would you like to make any statement as to any new facts which are suggested by the results of these investigations into the cumulative effect of arsenic?—Yes; that it has changed my views with regard to the cumulative effect—again reserving the word "cumulative" as being a relative term—that arsenic does remain much longer in the tissues of the body than I thought it possibly could.

3791. It comes rather to this, that the body is only capable of excreting a certain quantity of arsenic in a certain length of time?—Yes. Perhaps you will allow me to refer to the second case again. The woman was in hospital for 52 days, and yet arsenic was found to be present in the tissues. You cannot assume that she had taken that much more than the woman who had only been in hospital for 23 days, and in whom no arsenic was found. It was a typical case, according to Dr. Reynolds. There was pigmentation and all other

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Dr. J. D. Mann. symptoms. The only assumption is that there must have been some defect in the elimination as you have suggested where the tissues undergo such changes, and the vitality is so low that arsenic is eliminated very slowly indeed, and takes a long time. In the case of more vigorous persons it is got rid of much more quickly. In case of chronic poisoning the arsenic lingers in the tissues very much longer than I had any idea of, from my previous knowledge of acute cases and administering it medicinally for a moderately prolonged period.

3792. Have you any views with regard to the channels other than the urine by which arsenic may be eliminated?—Only those I have named.

3793. Would that throw any light on the fact that women seem to have suffered fatally much more frequently than men?—I think it is probably want of activity. I regard it simply as a question of elimination; many of these women were chronic alcoholics of the stout variety, who get very lethargic and do not move about nor go out of the house.

3794. And do not perspire?—That is so. Their tissues are not, so to speak, in activity.

3795. So that your opinion would be that next to urine, perhaps the skin is the great excretory organ?—The faeces and the bowels come next to the urine.

3796. I mean apart from the faeces and the urine?—Yes, the skin. The men are mostly obliged to move about. They have to do something, as a rule, and that is the only reason I can give for the difference.

3797. Have you any data which suggests what quantity of arsenic can be taken along with food for long periods without harm?—No; I do not think we are justified in committing ourselves to any statement of that kind. I should not do so, most certainly.

3798. What is your experience with regard to the idiosyncrasy of patients for arsenic?—There is undoubtedly idiosyncrasy. From personal observation I know there is idiosyncrasy towards arsenic in being easily susceptible. As to the converse of that I am not prepared to say. Oddly enough, only yesterday at the hospital I saw a case in which a girl had anæmia, to whom I had given arsenic. This girl was put on five-drop doses of liquor arsenicalis three times a day on the 17th January until the 18th February, when it was ceased on account of the evident indications of poisoning in the shape of coryza, and more particularly throat trouble; nothing else. The arsenic was stopped at once, and the symptoms rapidly subsided. Then on the 23rd February, knowing that arsenic would be beneficial to her condition, I tried her with five-drop doses three times a day of liquor sodii arseniatis, which is a much milder drug. This was continued for four days, and then ceased on account of a manifestation of the same symptoms. In the early part of March she had an erythematous rash on the legs; that was after she had ceased taking it altogether. Then on Saturday last, I think it was, she complained of distinct symptoms of neuritis, tingling particularly when one foot touched the other. The tingling was only in the feet. She had taken at the rate of 1-7th of a grain of arsenious oxide per day for 35 days, which would equal about 5 grains; and then in addition to that she had had about a little over half a grain of sodium arseniate. This produced these symptoms. Of course, these amounts are very much below what is frequently given medicinally. It was only given in 1-20th grain doses, three times a day in the first instance. Again, one has seen other cases of idiosyncrasy where even two or three five-drop doses have produced urticarial or other rashes. Those I have seen an odd time or two. Those were cases distinctly of idiosyncrasy.

3799. Reviewing those cases of arsenical neuritis which you have seen, has there not been extreme tenderness of the calves and in the limbs?—Yes; it has been very extreme.

3800. Had you associated that symptom formerly with alcoholic neuritis?—I have seen tenderness, but not this excessive tenderness.

3801. Was that a new feature?—Yes, it was a new feature. Formerly one used to find them tender, but frequently one used to have to grasp the calf of the leg to find it out. But now the patients dread your approach. That is distinctly a new feature, and to my mind one of very great import. Not only is the surface of the leg tender, but the whole of the muscles of the leg are excessively tender, and the patients lie in a crouching attitude, and cannot bear being moved at all.

3802. I believe many had to have cradles to prevent the bedclothes from touching them?—Yes. In those cases of contraction you may get the case of pseudoclonus by mild stretching, showing great irritability of the muscles.

3803. Are there any points that you would like to bring before the Commission as to the mode of testing for arsenic?—My observations have been conducted with the two recognised methods—Reinsch's and Marsh's. I have no personal experience, but I should not attach any importance to the so-called Gutzeit's method. Toxicologically you must not only get arsenic, but you must be able to prove that it is arsenic. With this test you get coloration, which may be due to a number of things. It may be antimoniated hydrogen, phosphoretted hydrogen, and sulphuretted hydrogen, and so forth. But in toxicological investigations where you have a man's life at stake you must be able to prove absolutely that it is arsenic. You can do that with Reinsch's test and Marsh's test: you can convert and reconvert and satisfy yourself that the thing you get is what you assume it is.

3804. Do you wish to make any remarks of the computation of the amounts of arsenic found in beer?—Judging from the amount I found in the different channels of elimination, I should say that more arsenic has been present in the beer than the analyses have accounted for. I am not criticising the analyses, but that is the impression that I have had.

3805. (Professor Thorpe.) Do you mean that by the methods which have been used the quantities obtained have only been approximately quantitatively accurate?—That is my impression.

3806. They are only approximate to accuracy?—Yes. I believe that to make an absolutely accurate analysis of beer with arsenic in it is a very laborious and time-consuming process.

3807. (Chairman.) On the whole your impression is that the amount of arsenic in beer has been under-estimated rather than over-estimated?—That is my impression from what I have seen clinically and from the amount I have observed in the excretions.

3808. (Professor Thorpe.) That must follow, inasmuch as when the Reinsch method has been at the basis it primarily depends upon the power which the copper has of picking up the arsenic—to the extent that the copper has neglected to take up the arsenic—it will minimise the amount of arsenic which is detected?—Quite so. With Reinsch's test, it is almost like exhausting a vessel of air. With regard to Marsh's test, even in the small amounts in my investigations in which the hydrogen was coming away so small that it would only produce if it was lighted a bead about the size of a pin's head; and, notwithstanding that, you might have an inch of the tube incandescent, I could by its odour detect arseniuretted hydrogen coming away which had not been dissociated. That was corroborated by a piece of filter paper with a drop of nitrate of silver solution, which would rapidly—in two seconds—colour. Coming back to the Gutzeit test, with mercury chloride similarly applied, it took thirty seconds before it was coloured. With the old nitrate of silver method you got in two seconds a slight coloration—holding it close to the end of the tube.

3809. Then you infer from that that mercuric chloride is less sensitive than nitrate of silver?—Yes, that is my experience. On the other hand, nitrate of silver would not do for the test on account of reduction by light. Mercuric chloride is undoubtedly less sensitive to the appreciation of arseniuretted hydrogen.

3810. (Dr. Whitelegge.) You attribute the recent epidemic to arsenic?—I do.

3811. Do you attach importance to the association of arsenic with alcohol?—Yes, as regards the capacity of the tissues of the recipient to eliminate—in that sense I do.

3812. The same amount of arsenic administered in another form might not give rise to the same amount of mischief?—Assuming that people do not take alcohol. I do not think that the arsenic being in the presence of alcohol in the beer caused any material difference, but the fact that the people who took it had been beer drinkers, and whose tissues were previously, I take it, more or less impaired, and their eliminative power correspondingly diminished—then you would get accumulation.

3813. Some of them, we were told, are moderate drinkers, but in general the alcoholic habit would render

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Tests for arsenic compared.

Toxic effect of arsenic increased by alcohol

Dr. D. Mann. them more susceptible to the injurious influence of arsenic?—Decidedly, in my opinion.

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3815. The suggestion has been made, but we have not had any evidence upon it?—I have no reason to think that they have.

Pigmentation. 3816. Have you made any examination for arsenic in the pigmented parts of the skin?—I have not had the opportunity. It is a very difficult and moot point. It has been hitherto supposed that it was altered blood-colouring matter, and not arsenic. On the other hand, some observers have different views. It is not a settled point as to what the pigmented matter is.

3817. Assuming arsenic to be deposited in the internal organs, is there anything known about drugs bringing it back into the circulation, anything comparable to the supposed effect of potassium iodide in the case of mercury?—No; I do not think there is, and I do not think that any drug would influence it.

No amount of arsenic in food should be declared a negligible quantity. 3818. You are not prepared to say that any amount of arsenic in food is a negligible quantity?—No.

3819. You would not say, therefore, that it would be wise to assert that anything less than 1-20th of a grain in a gallon of beer was immaterial to public health?—I am sorry to have to differ from my friend Dr. Stevenson, who has formulated that, but I do in this instance. I cannot accept the statement that 1-20th of a grain in a gallon would be innocuous. This epidemic has put a lot of negative as well as positive information before us. We have no knowledge as to what the effect would be of the constant ingestion of very minute doses of arsenic. It is difficult to compare the medicinal administration of arsenic, where the doctor and nurse know, and when it can be cut short should anything arise, with the taking of arsenic from multitudinous sources and not knowing it, where symptoms go on increasing and the mischief goes on *pari passu* with the taking. We do not know what the effect is. I most emphatically must decline to associate myself with any limitation whatever.

3820. Even a more stringent one than the 1-20th of a grain?—If you put an absurdly small quantity, of course, one could imagine it to be a negligible quantity; but that would defeat its own object, because it would not be practicable.

No reason to suspect selenium as concerned in epidemic. 3821. (Chairman.) Has any suspicion ever crossed your mind that any other substance than arsenic might be to blame for this epidemic?—No. I presume you refer to selenium. I have no reason at all to believe that selenium entered into the matter. I do not doubt that there may have been selenium present, but

we know that arsenic will produce these symptoms; and I feel satisfied that there was sufficient arsenic present to produce them. Therefore, in my own mind, I am perfectly convinced that arsenic is the sole factor in the production of those symptoms. J. D. 26 M.

3822. Have you looked for selenium in any of your cases?—No. In the tissues you can hardly look for selenium unless it is present in a considerable amount. In Marsh's test you do not get it over. It precipitates on the zinc. It is stated that you do get it over with the arsenic. That may be so; but I have tried one or two rough experiments with that view with Marsh's test, but I could get no deposit. I have no indication that would afford me any idea that anything other than arsenic was present.

3823. You have not examined any of the beers, have you?—No; it is not in my province to examine beers. I may say, further, that I do not attach any importance to the idea that there is any organic combination of arsenic. I think there is sufficient arsenic present in beer as a simple form to account for the symptoms.

3824. Do you know what the pharmacological action of selenium is?—I do not. There are no instances recorded of selenium poisoning in the human subject. They are all experimental.

3825. It is stated, is it not, that it produces great wasting?—I have seen it stated, but I have no knowledge of it.

3826. Has wasting been one of the great features of this epidemic?—Not beyond a reasonable amount.

3827. Not beyond what you would expect with the paralysis?—No.

3828. In fact, many of these patients have had a large quantity of fatty tissue about them, have they not?—Yes. Casting my eye back, I cannot remember cases of extreme emaciation at all, not as one would get in ordinary alcoholic cases of cirrhosis of the liver, where you get a big abdomen with very thin legs and arms.

3829. But the wasting in these cases has not been out of proportion to the shrinking of the muscles from the paralysis?—Certainly not.

3830. (Professor Thorpe.) Were your Marsh mirrors what you might call normal arsenical Marsh mirrors?—Yes.

3831. Was there nothing in their appearance to attract any unusual attention to them?—No.

3832. I presume you are aware that when the selenium is deposited upon a Marsh mirror it gives a brick-red or vermilion tint?—Yes.

3833. Nothing of that kind occurred in the Marsh mirrors that you saw?—No.

Mr. W. R. DEAKIN, called; and Examined.

Mr. W. R. Deakin. 3834. (Chairman.) I believe you are the representative of the Manchester Brewery Co.?—Yes.

3835. Have your breweries been customers to Messrs. Bostock's?—Yes.

Use of Bostock sugar by Manchester Brewery Co. 3836. For how long?—We have been customers ever since we have been a company—about 12 years, and I think before that time also.

3837. Had you obtained both sugar and glucose from them?—Only glucose.

3838. Do you use Messrs. Bostock's exclusively, or do you use other makers' glucose?—Seventeen per cent. of the whole of our glucose was Bostock's.

3839. Do you get the invert sugar which you use from other makers?—We do not often use invert. We use a mixture of invert and glucose—Mabre's.

3840. Do you use invert for priming?—We use this mixture for priming and also for brewing.

Proportion of glucose in beer. 3841. In what proportion do you use the glucose in brewing? I suppose in different brews you use different quantities?—Yes; we use from about 14 to 20 per cent. of glucose, according to the beer.

3842. (Dr. Whitledge.) Is that the percentage on the total amount of brewing materials?—Yes.

Priming. 3843. (Chairman.) Do you prime all your beers?—Very nearly all. Occasionally we do not do so in the summer, but you may take it that we prime all our beers.

3844. Do you prime them all in the same proportion?—No; we rather vary the proportions. We use from a pint to a quart. In some fourpenny beers we use a quart, and in the stouts we use a quart; but in the better ales—mild ales and bitter ales—we use only a pint to the 36 gallons, that is at a gravity of 1.150. M. I.

3845. What steps did you take after the discovery of arsenic in Bostock's sugar?—As soon as we discovered that arsenic was in Bostock's sugar we destroyed all the beer that had Bostock's sugar in it. Every barrel that had any Bostock's sugar in it was immediately destroyed. Acti brev disco arse

3846. You destroyed all the beer that you had at the brewery?—Yes; and in our houses. We sent our agents around to the houses, who personally saw the beer put down the sewers. We did not leave it to the customers to do; we did it ourselves.

3847. Do you know what quantity of beer was destroyed?—I should think about 1,250 barrels. Qu beer dest

3848. (Dr. Whitledge.) Do you supply beer to customers other than the tenants of your own houses?—Nearly all our beer is supplied to our own houses. It is mostly a tied trade, but we do supply private customers.

3849. What did you do with the beer supplied to them?—We only supplied them with bitter beer. Bostock's sugar was only used in sixpenny beers, and none of that was supplied to those customers. We did not

use Bostock's sugar in any other beer except sixpenny beers. The beers supplied to the private customers were all right.

3850. (Chairman.) I suppose none of those sixpenny beers are bottled?—No.

3851. Was any action taken by the sanitary authorities to prevent your selling or using any of the incriminated beer?—At Wolverhampton we were summoned, but we were not summoned anywhere else. We were summoned there on two beers and a stout, one of which had Bostock's sugar in it, while the other two had not. One, however, was found not to contain arsenic after all; and on the other one we were convicted. Our man was going round at the time when these samples were being taken, but he arrived at this particular house half an hour after the sample was taken.

3852. What time elapsed between your being aware of there being arsenic in your beer and your destroying all the beer?—I should think the last barrel was destroyed within two days of our knowing about it.

3853. Then your trade is within a limited area. I suppose you have a good many houses?—I think we had nine people going around destroying the beer, working up to eleven o'clock at night. We had two men going round in the Wolverhampton district where this took place, but they were not quite quick enough.

3854. (Dr. Whitelegge.) In the Wolverhampton cases one sample was found to contain no arsenic?—All three chemists differed. Somerset House found arsenic in two cases, but not in the third. Mr. Jones, the Wolverhampton analyst, found arsenic in all the cases; while our own analyst found arsenic only in the one that had Bostock's sugar in it. In the other two he found none. Mr. Jones and Mr. Heron and Somerset House gave totally different analyses.

3855. Could you give us the figures of those different analytical results?—This paper gives them:—

"The samples from the three houses were analysed by three different analysts with the following results:—

In No. 1. Beer (from the "Crown," Wolverhampton).

Brew 692.

Mr. Jones (public analyst) found .07 grs. per gallon.

Mr. Heron " " .02 "

Somerset House " .38 "

In No. 2, Stout (from the "Crown and Anchor").

Brew 693.

Mr. Jones (public analyst) found .05 grs. per gallon.

Mr. Heron " " nil. "

Somerset House " nil. "

In No. 3, Beer (from "Royal Oak," Wolverhampton?).

Brew 683.

Mr. Jones (public analyst) found .09 grs. per gallon.

Mr. Heron " " nil. "

Somerset House " .19 "

Case 1.—Tenant fined £5 and 22s. costs.

" 2.—Dismissed with costs against the Wolverhampton Corporation.

" 3.—Manager fined £6 and 22s. costs; Company fined £7 and 22s. costs."

3856. Were these three portions of the same samples submitted to three different analysts?—Yes. In two cases the beers were made from exactly the same malt. In one case Somerset House found no arsenic, and in the other they found 0.19 grains. The beers were made from exactly the same malt.

3857. I suppose all these beers would be primed?—Yes; they all had been primed with the same sugar—Manbré's. We never used any of Bostock's sugar for priming.

3858. (Professor Thorpe.) Was there any sample of beer which had Bostock's sugar in it?—Yes, that is the case where all three analysts found arsenic. There was no Bostock's sugar in the other two samples.

3859. (Dr. Whitelegge.) In the case where the analysts agreed in finding arsenic was Bostock's sugar used in the brewing or in the priming?—In the brewing.

4576.

There is no Bostock's sugar used in the priming of any of them.

3860. (Chairman.) You have never used Bostock's in the priming?—No.

3861. Therefore, you think it would be impossible that by accident some barrels were primed with Bostock's?—Quite impossible.

3862. What steps are you now taking to prevent your beer from being contaminated?—We are getting guarantees from all our customers, both of malt and sugar, now being With the invoice they send a note that they guarantee it free from deleterious matters. We are also having our beers analysed by Dr. Miller.

3863. (Dr. Whitelegge.) Every brew?—The beer from every fresh lot of malt is analysed, and each consignment of sugar is analysed as it comes in, so we go on brewing from that malt and sugar until it is finished. We send a sample of the beer to be analysed, and then and we go on and finish it. Then, when the next lot comes analysed in we have it analysed again. If the first lot is passed as free, we conclude that the whole of that consignment is free.

3864. Do you analyse the malt and sugar yourselves, or do you only analyse the beer?—We analyse all three.

3865. Do you send samples of every consignment of malt and every consignment of sugar to Dr. Miller?—Not quite, but pretty nearly every one. We have not had any arsenic since December.

3866. (Chairman.) Have you had any difficulty in getting these people to give these guarantees?—We have not had any difficulty; but the maltsters did not like it. This is the sort of letter we get from them. Here is a letter (produces) from Sandars and Co., one of our maltsters. He did not like giving a stringent guarantee of freedom from arsenic, though he is willing to accept return of the malt if it does not meet the views of our chemist. In that case we have still insisted on the guarantee.

3867. (Dr. Whitelegge.) What was the form of certificate you obtained?—Here it is; it is on the invoice. (The invoices were handed in.) I have brought you one of each.

3868. Arsenic is not specifically mentioned?—No; it says "deleterious matters." With some of them I believe arsenic is actually mentioned.

3869. Do you suggest any precise terms of certificate, or do they send you some certificate of their own wording?—That is what I ask them to put on. It says there: "Guaranteed free from any substances deleterious to health." We have no difficulty with anyone except our maltsters.

3870. You do not ask whether it is dried with anthracite?—No; we have their assurance that it is.

3871. And this certificate is understood on both sides to cover complete absence of arsenic?—Yes.

3872. Has this demand on your part led to any increase in the price?—No.

3873. Is it within your knowledge how the malt is dried?—We have their assurance that it is dried with anthracite coal.

3874. A general assurance?—Yes. I have spoken to them about it, and they have all assured me that it is dried with nothing but anthracite coal.

3875. Do you ask for any certificate of that kind as regards hops?—No. We have bought all our hops; we have not bought any since this scare came on; we have not any guarantee about that.

3876. Have you had any examined?—Yes, we had one lot examined, and it was all right.

3877. (Chairman.) Do you malt for yourselves as well?—No.

3878. You buy entirely?—Yes.

3879. Where do you get the chief quantity of your malt?—Our chief supply is from Sandars, of Gainsborough, and Manns, of Wakefield, also supply us with a good deal. I am in touch with Dr. Miller, and I know their malts are all right in corroboration of their statement.

3880. The bulk of your malt comes from the Eastern counties, not from Shropshire or Shrewsbury, which is a big malting place?—Most of the malt comes from Lincolnshire—I think the majority of our malt this year. We have not had very much Yorkshire, but some of it was made in Yorkshire, on the canal, by Sandars.

T

Mr. W. E.
Deakin.
25 Mar. 1901.

Change from
coke to
anthracite as
malting fuel.

Screening
and brushing
of malt.

Brewers'
books show
origin of
materials.

but Excise
books do not

Excise
Officers could
ascertain
origin of
brewing
material and
take samples.

3881. I suppose you are not able to tell us anything about the character of the fuel which was used before this scare in the maltings that you deal with?—I understand that it was coke.

3882. You do not know anything of the source of the coke?—No.

3883. Before this scare used you ever to submit your materials for analysis to anyone?—Yes; we have had a contract with Dr. Miller now for nearly two years.

3884. His analysis, I believe, was only for trade purposes, as he told us yesterday?—Yes. Directly this scare came out, before we knew what it was, I sent samples up to Dr. Moritz, in London, and I asked Mr. Estcourt to come in, and he took samples of the beer as it was going out from the brewery, as well as samples of the materials, and he found that they were all pure. Dr. Moritz corroborated him, and found the samples pure.

3885. (Dr. Whitelegge.) When was that?—The last week in November.

3886. Were they reported free from arsenic?—Yes.

3887. (Chairman.) Do you make any conditions with the people from whom you get material that it shall be properly screened and brushed?—We have no written agreement; it is verbal. Of course, we have talked to them pretty straight about the whole thing.

3888. You did that before this scare?—Yes. We have always been particular about that. In fact, we dropped one or two maltsters because they did not satisfy us in that respect.

3889. (Dr. Whitelegge.) Why did you take exception to it not being brushed and screened?—It makes a great deal of difference, I always think, in the beer if the dirt is in. We screen it at the brewery as well, but it means a lot of work for our own screens.

3890. But you had no suspicion of arsenic?—No, it was simply a question of cleanliness—to get out mould and broken corns, and that kind of thing.

3891. (Chairman.) Can you trace from your books the composition of your beers and where the materials come from?—Yes. I produce my brewing book. You can see by it that we know exactly what is in every brew. (The brewing book was produced, and certain entries explained to the Commissioners.)

3892. (Dr. Whitelegge.) Can you trace these barrels?—Yes. As every barrel is racked the number is entered in the book, together with the name of the customer. I have not brought that book with me.

3893. (Chairman.) I see by this book that each brew can be clearly traced as well as the sugar, etc.?—Yes. We could trace which had Bostock's and which had not.

3894. You make returns to the Inland Revenue to show the quantity of malt substitutes you use?—Yes. We enter those in the Excise books. We do not enter the hops.

3895. (Dr. Whitelegge.) You do not enter the details of the malts and the sugar, do you?—We enter the quantity.

3896. The total quantity?—The exact quantity of each brew.

3897. You would not say how much is Bostock's sugar?—No, we should not give the name of the firms. We should say so many hundredweight of sugar, so many quarters of malt, and so many quarters of maize or rice, but we should not give the names of the firms who supply them.

3898. (Professor Thorpe.) That is to the Excise officer?—Yes, in the ordinary Excise book.

3899. The Excise officer, if he chose, could ask to see the names of the firms?—Yes, and he could take samples if he wished.

3900. If he wished he could know the names of the firms with whom you are dealing?—Yes, we should have no objection to telling him, but, as a matter of fact, they never asked.

3901. I see in the materials here in your brewing book these four columns give malt, corn, sugar, and hops?—Yes.

3902. You put other things besides those into your beer, do you not?—We put preservatives in and finings. I think those are the only two things we put in. Finings, of course, go in, but we do not enter them there.

3903. Do you never use any hop substitutes?—No. Those are the main things. Nothing goes into the barrel except what is down there with the addition of a little preservative.

3904. Have you taken any precaution to see if your finings are pure?—I have had them analysed, but only once.

3905. (Dr. Whitelegge.) For arsenic?—Yes.

3906. (Professor Thorpe.) I suppose you use isinglass?—Yes, with the usual tartaric acid. The finings were quite pure the only time we had them analysed.

3907. (Chairman.) Is nothing added to give a head to the beer?—Yes. I was wrong in saying there was nothing else. There is a stuff—some sort of sugar I think it is—and I had that analysed as well. That was found to be pure.

3908. There are a great many other substances used in the trade, are there not, to saponify the beer to a certain extent?—I believe there are.

3909. You know nothing about them?—We do not use them. I may mention that the other day we received this letter with regard to a beer which had been passed as being all right. (Letter handed in.) You will see it states that one hundredth part of a grain per gallon has been found in that particular beer. How on earth they could detect it I do not know. It is very worrying to our customers, but it does not worry us very much.

3910. This is from the Public Health Department at Stockport?—Yes. We had one once before from there.

3911. Was this particular beer brewed with Bostock's material?—No. It was brewed quite lately, and all materials had been passed as pure. The analyst has found, as you see, approximately one-hundredth part of a grain per gallon.

3912. Had any of the barrels in which this beer was placed before contained beer brewed with Bostock's?—It is possible. It is a quick trade. The barrels are washed and scalded and steamed every time they are used. I do not think there can be anything from them.

3913. (Dr. Whitelegge.) Have you traced these samples to their source in this book?—No; I have not had the number of the brew yet. I know there is nothing, however, which has not been passed as sound, because all the beers have been brewed recently—certainly within the last month.

3914. If I understood you correctly, not quite all the samples are submitted to analysis, are they?—No, they are not.

3915. Are the ingredients?—The ingredients are practically all submitted to analysis. All fresh stuff is analysed.

3916. (Chairman.) Can you be quite certain when you take a sample of malt that all the quarters of malt are really from the same drying?—We have the assurance of the maltsters that they are. That is all.

3917. (Professor Thorpe.) Are you a chemist, or have you had any chemical training?—No. I know enough chemistry to analyse beer for commercial purposes. That is all.

3918. Did you attend the proceedings at Wolverhampton?—Yes.

3919. Was any evidence given as to the methods upon which the various chemists based their statements?—Mr. Heron said he made his experiments with Marsh's and Reinsch's tests, and Mr. Jones said he did his also with those tests. He said that he had tried those tests over and over again. He had only a pint to start with, and he found arsenic every time. They both said they duplicated their tests.

3920. Do you know if their description of the mode in which they applied Marsh's test and Reinsch's test was identical?—I fancy that Dr. Jones said he used identically the same method as Mr. Heron. I believe the question was asked, but I forget at the moment, although I fancy they both used exactly the same tests.

3921. Did Mr. Heron say he used what is known as the experts' test?—Yes, I believe he did, because he described exactly how he had done it.

3922. Mr. Jones did not use the experts' test?—I rather fancied he did not. He had some method of his own.

Mr. B.
Don.
26 Mar

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3923. When Mr. Jones found arsenic he found it in greater quantity than Mr. Heron?—Yes.

3924. And when Somerset House found arsenic they found it in greater quantity than either?—Yes.

3925. The amounts of arsenic found by Somerset House were about twice that found by either of the other experts?—Yes; they were rather more, except in the one case where they found none.

3926. Did you notice anything peculiar about Bostock's glucose as compared with other glucoses that you had been having?—No, nothing at all.

3927. It was not any darker in colour?—No; if anything, it was a lighter colour, but I do not think there is very much in it. It was nice-looking sugar.

3928. Did you notice anything peculiar about the yeasts which you were obtaining during the time of this trouble?—No.

3929. There was nothing abnormal in them?—We had not very much of Bostock's; we had only 17 per cent. of the whole lot.

3930. I am speaking of the yeasts now?—No.

3931. (Dr. Whitelegge.) Do you send out any guarantee with the beer you supply to customers?—No; we have not been asked for it.

3932. Neither to your tied houses nor to your other customers?—No.

3933. Would you object to supplying such a guarantee?—With the present system of public analysts, we certainly should. If there is a standard laid down that we could depend upon I do not suppose we should, but now if you send these samples to six different men, not any two would agree, and we should not like to give a guarantee. If there was some fixed standard which was worked to, we should not mind.

3934. (Professor Thorpe.) And by a prescribed method?—Yes; and there should be men trained to do the work. If, for instance, Somerset House had the control of it one would not mind, but I do not think we should like to feel we were in the hands of the local authorities, where each different public analyst has some method of his own of making the analysis.

3935. (Dr. Whitelegge.) You think in the absence of such a prescribed method the brewers have a grievance?—I think so undoubtedly; we do not know where we are.

Mr. C. ESTCOURT, called; and Examined.

3948. (Chairman.) I believe you are a Fellow of the Chemical Society and a Fellow of the Institute of Chemistry?—Yes.

3949. And you were one of the founders of the Society of Public Analysts?—That is so.

3950. I believe you have been Public Analyst of Manchester for the last 28 years?—I have.

3951. And for more than 20 years the administration of the Food and Drugs Act has been carried out by a Committee of the Corporation with the aid of the chief superintendent, Mr. Rook?—Yes.

3952. And I believe you have given advice upon chemical matters yourself connected with such authority?—Yes, up to four years ago.

3953. You also act as Public Analyst for Bacup, Lancaster, and Ashton-under-Lyne and Macclesfield?—Yes, and for Oldham.

3954. You are associated, I think, in one place in Macclesfield and Ashton-under-Lyne with the chief sanitary inspector and at Bacup and Lancaster with the Chief Constable?—That is so; and at Oldham with the Medical Officer of Health.

3955. Would you like to make a statement with regard to what you consider to be your duties as Public Analyst in connection with those bodies?—My duty as Public Analyst would be to ascertain the presence of any compound added to alter the appearance or increase the bulk, or to ascertain if a compound had been deprived of any valuable constituent. No public analyst has imagined nor has it ever been suggested that he should look for all possible contaminations. The Act seems to have been originally intended to prevent fraud. Where a poison is introduced under the third section it is a poison, I take it, which would enable them to imitate or to alter the character of the article so as to sell it to

3936. If one of your tied houses supplies beer which is found to be arsenicated, of course they inform you?—Yes. The authorities inform us, and they inform the house where the sample is taken from.

3937. Is it your practice to defend the case for them?—We have only had the one case I have mentioned, and we defended that for them.

3938. That was at Wolverhampton?—Yes.

3939. Have you had no other cases?—We have had no other cases against us at Manchester and Salford, where the bulk of our business is.

3940. In what way would your position be different if you gave a guarantee since you undertake the defence?—I suppose they could come down upon us for the loss of trade and all kinds of things.

3941. Would that arise in the case of a tied house?—No; possibly not in the case of a tied house, but in the case of a tenant I suppose he could claim damages. We should not have the least objection as long as there was some standard that we could work to with some confidence. We cannot do so now. You may brew beer with every ingredient guaranteed pure, and the beer passed pure by Dr. Miller, and then we get the sort of letter I have shown you, stating that 1-100th or 1-200th of a grain of arsenic per gallon has been found in it.

3942. Do you know that some breweries are supplying guarantees?—I have seen labels upon barrels; that is all I have seen.

3943. What are the preservatives—sulphites?—Yes.

3944. Have they been analysed?—Yes.

3945. And in all cases they have been found to be free from arsenic?—Yes; there is a certificate of that.

3946. (Professor Thorpe.) What steps have you taken to eradicate the traces of arsenic from your plant?—We scour and scrub it well over and over again with sand and all kinds of things which would fetch any rough substance off. We have used bi-sulphite, but I do not know whether that would do it.

3947. Has your company made any claim for the return of duty?—We have not done so at present. I have the telegram here from the Brewers' Association, asking us not to sell beer made from Bostock's; before receipt of which all our contaminated beer sold to customers had been destroyed. I have also here letters from Messrs. Sandars after I had refused to accept that other letter of theirs. Other maltsters have done the same.

a greater advantage, as in the case of peas which are made green by the sulphate of copper.

3956. (Professor Thorpe.) Would not Section 3 also cover a case of the use of a thing like the chromate of lead?—Yes, it would.

3957. And possibly the use of a pernicious green colour for giving so-called pleasant appearance?—That is so. Twenty-eight years ago chromate of lead was considerably used in cheap confectionery in Manchester. A prosecution ensued, and it was stopped. I do not recollect a case since.

3958. Is it not within your knowledge that Section 3 Principal was drafted to cover cases such as those?—Not of accidental impurities, but of intentional impurities. I have in my mind now the possibility of the contamination of milk by germs of typhoid or scarlet fever, and the possibility also of that particular sample of milk being submitted for analysis by the analyst. He passes it, and hitherto he has not been blamed, although as a result of the consumption of that milk some diseases have been spread. That is an organic contamination. Arsenic is an inorganic contamination. That is the whole difference. Neither of them is fraudulent to the Act, because they do not alter the appearance of the article. In the case of arsenic the beer is not altered in appearance, weight, or strength in any particular.

3959. (Chairman.) I think you consider that it is the duty of a public analyst to examine for probable causes of accidental contamination?—That is so. I can give you an example of that kind in the various soda waters of commerce which were formerly conveyed through leaden pipes. We invariably looked for both copper and lead. That is not an adulterant in any sense, but it is a probable contamination.

Mr. W. R. Deakin.
26 Mar. 1901.

Arsenic used remaining in brewing plant.

Mr. C. Estcourt.

adulteration.

Mr. C. Edcourt. 3960. And in future, I presume, you would look for arsenic in beer?—I should, unquestionably.

25 Mar. 1901. 3961. Perhaps you would give the Commission some information with regard to the analyses which you have made since this poisoning has been found out?—I have received and analysed samples of beer since November 21st of last year from the following authorities: from the Manchester Corporation, 81 samples; from Oldham, 5; from Ashton-under-Lyne, 40; from Macclesfield, 24; from Lancaster, 22; from Bacup, 18. The results in Manchester were that one sample had not less than 1-7th of a grain, ten not less than 1-8th of a grain, one not less than 1-9th of a grain, one not less than 1-12th of a grain, two not less than 1-15th of a grain, one not less than 1-20th of a grain, two not less than 1-30th of a grain, eight not less than 1-50th of a grain, twenty-two not less than 100th of a grain, five not less than 1-200th of a grain, and twenty-eight were absolutely free.

Quantities of arsenic found in beers in different localities.

3962. (Professor Thorpe.) Perhaps you had better explain to the Commission precisely why you use such a phrase as "not less"?—A public analyst's duties are to certify. He has to be exceedingly careful that he shall not exceed the estimate of the quantity that is there. That is one reason why I have used the term, and one reason why I have estimated so that my quantity would be rather less than the quantity present. I may explain that in making a standard I have taken a standard Marsh mirror obtained from water and not from beer. The consequence is my standard reduces the apparent quantity from beer, as you will see. I got the whole of the arsenic from the water solution practically. You may take it that I get more than I could from beer. If I place a certain specified quantity of arsenic in water and Reinsch it and use the Marsh test with it, I should find a certain quantity as a standard—a certain colour. If I took the same quantity of beer I should get a smaller quantity as a result, which would be a safer test. Taking the water standard and then analysing the beer, my result is always less as certified than is actually present.

Detection of arsenic in beer and in water compared.

3963. (Chairman.) But that is rather different from the evidence we have had from others, who have said that the detection of arsenic in beer is more marked than the detection of arsenic in water?—I do not recollect having heard that.

3964. (Professor Thorpe.) It has been stated to us by a chemist that it is easier to detect the presence of arsenic in beer than in the same bulk of water?—There should be some grounds given for a statement like that. It is contrary to all received notions, and contrary to all my experience.

3965. (Chairman.) I only mention that it has been stated?—It is an extraordinary statement.*

Limits of error in estimating arsenic.

3966. (Professor Thorpe.) Have you any idea in your own mind as to the relation between the amounts that you have given and what would be the actual quantities in the beer?—I should say at a guess that 1-8th might be 1-7th, and 1-7th might be 1-6th. That would be the proportion. Of course the certificate of the Public Analyst is subject to the review of Somerset House as well as to the review of the brewer's chemist. The analyst is not in the same position as an investigator, as the gentleman who investigated the matter at Owens College.

3967. (Chairman.) I presume the difficulties would be greater when you are dealing with very small quantities than when you are dealing with larger quantities?—Undoubtedly.

3968. What you estimated 1-8th might be 1-7th?—That is so.

3969. But what would it be when you came down to 1-100th?—1-100th might be $\frac{1}{100}$ th.

3970. Keeping up the same ratio?—Exactly. In the first samples I got, as you will see in the list, there were six which were below 1-30th. Some were 1-200th, 1-100th, 1-50th, 1-30th, 1-12th. As a consequence I had to deal practically with the small quantities only, from 10ozs. or 11ozs., and I had also to deal with unknown quantities as to the composition of the articles;

Note by Witness.—As an illustration of the fallacy of this, three public analysts analysing portions of the same sample of beer found respectively 1-10th, 1-12th, and 1-25th grain. One thus lost half the quantity present. All would have got correct results from a solution of As_2O_3 in water.

that is to say, instead of being beer, as I had imagined it, it was beer plus something. The highest quantity of arsenic is found in the cheaper beer, and that cheaper beer is one that contains not only preservatives, but it is fined. Directly it gets into the retailer's cellars, he pours in a certain amount of isinglass. Therefore, as received then, the beer would contain a considerable amount of sulphites in some form or another. This I did not know until six days afterwards, when I obtained from a brewer samples of finings, and all the materials he used. I then recognised the character of the beer as sold at the present day.

3971. (Professor Thorpe.) Had the fact that the beer contained preservatives any influence upon the determinations of the amounts you discovered?—It had an influence upon the discovery; but upon the amounts discovered I should say no, because I used the means to get rid of the sulphites in the estimation of every case.

3972. It would prevent your recognising arsenic in the first instance?—It did.

3973. By inadvertently not ascertaining the existence of the sulphites you failed to discover the presence of the arsenic?—By not knowing that the sulphites were present in the beer.

3974. You knew that sulphites might be present in beer, did you not?—Not in beer.

3975. You were not aware that sulphites were used as a preservative?—No; I was aware that sulphites were used, bi-sulphite of calcium, to wash the barrels with, but never that it was added to the beer.

3976. You understood that preservatives were added to the beer, I presume?—I cannot say that I did. I had not the faintest idea that sulphites were present.

3977. (Chairman.) You put in this table with regard to Manchester?—Yes. (See Appendix, No. 9.)

3978. And you also put in a table with regard to Ashton-under-Lyne?—Yes. You will see that the amounts of arsenic per gallon varied from 1-7th of a grain to 1-200th, and seventeen of the samples were free from arsenic.

3979. And you also put in a table with regard to Macclesfield, Bacup, and Lancaster, and a summary of results obtained by you when analysing beers submitted to you by brewers?—Yes. (See Appendix, No. 9.)

3980. Do you know where the brews were brewed?—Yes; I can give you the particulars if you like.

3981. Did you find any arsenicated beers excepting those that had used Bostock's materials?—In brews brewed entirely from malt and hops I found arsenic also.

3982. (Dr. Whitelegge.) What was the most in those cases?—I think I got from 1-4th to 1-50th of a grain per pound.

3983. (Chairman.) Was that in the malt?—Yes.

3984. I am speaking of beer; that was in your samples of malt?—Yes; I obtained the malt from which the beer had been brewed in which I found arsenic.

3985. You first found it in the beer, then you obtained samples of the malt and found it in the malt?—Yes.

3986. (Dr. Whitelegge.) How much was there in the beer?—I found 1-10th of a grain, if I recollect rightly.

3987. (Professor Thorpe.) One-tenth of a grain per gallon?—Yes.

3988. (Chairman.) I believe you have made numerous analyses of glucose, invert sugar, and caramel?—Yes, with the result that I found two other glucoses containing arsenic, one in a considerable quantity.

3989. Not Bostock's?—No.

3990. Do you know from whom they came?—I can give you the name of one. The other was an American firm. The one that contained the most was German made. Julius Frank and Ohlmann was the name.

3991. They were both foreign?—Yes, I presume so.

3992. (Dr. Whitelegge.) How much was there of the samples?—Enough to make 1-20th of a grain per gallon if 20 per cent. had been used. I am taking that 8 ounces might be used to replace the malt in these cases—taking 42 ounces of malt to make a gallon of beer, which weighs about 10lbs., and replacing a portion of the 8 ounces with sugar it becomes about 1-20th of a

Mr. Edcourt.

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Arsenic detected according to presence of sulphite

Quantities of arsenic in beer in different localities

Arsenic in all malt

Arsenic in malt

Arsenic in non-B glucose

Of German and American origin.

Mr. Estcourt. grain. The quantity of arsenious acid estimated to exist in 1lb. of the glucose was $\frac{1}{10}$ of a grain. The estimation was by means of comparative Marsh mirrors.

Mr. 1901. 3993. (Professor Thorpe.) Was that German glucose you refer to being actually used in the manufacture of beer?—It was from a brewer's premises.

3994. In this district of Manchester?—Yes.

3995. (Chairman.) And in the American glucose you also found arsenic, but in a less quantity?—Yes.

3996. Was that also obtained from the premises of a brewer?—Yes, from premises of a brewer in the neighbourhood, though not in Manchester—a town 20 miles away.

3997. Do you think that it was being used for beer?—Yes; it had undoubtedly been used.

3998. For beer—not for any other purpose?—Yes, they used it for beer.

3999. Still, glucose is used for other purposes?—Yes, for a number of other purposes, jams and various sweetmeats.

4000. Have you made any analyses of jams?—Yes, I think I have given you some figures.

4001. (Professor Thorpe.) Was this German glucose which you got from the brewer the only sample of German glucose you got from a Manchester brewery?—It is the only German glucose that I know of.

4002. Can you tell us whether imported German glucose is at all extensively used in this district?—I should say that this particular glucose had a considerable sale, as I met with it in several other breweries.

4003. I understood you to say that you had not?—Yes.

4004. This German glucose?—Yes.

4005. It contained arsenic?—Not in all cases. This was a case where the beer appeared to contain a very small quantity of arsenic. They used none of Bostock's. They bought at the best prices, and they got this particular glucose from Julius Frank and Ohlmann. He gave me a sample of another stock in which I found a faint trace; but afterwards in the brewery to which I allude I found some glucose from Julius Frank and Ohlmann which contained a much larger quantity, the quantity I have spoken of. The glucose of that firm has a considerable sale in the neighbourhood.

4006. What do you mean by a "considerable sale"?—They supply several brewers.

Mr. several appear to buy in a very peculiar way; that is to say, they have three or four makes of glucose in at a time. They used in a most extraordinary way mixtures of the glucoses according to the taste of the brewer. Although I cannot tell you to what extent it is sold, I should say there is a considerable sale. Their business is entirely glucose.

4008. As these breweries which use this German glucose in which you found the arsenic large breweries?—I have not been to the breweries, but I should say they are of considerable size.

4009. This is the first distinct evidence we have had of the occurrence of any notable quantity of arsenic in any other than Bostock's glucoses?—I wrote to the Officer of Health here on the 7th December, and told him that there were two other glucoses in which I had detected arsenic. I think, however, I am not alone in this, for Dr. Campbell Brown also says that there are two other cases in the report.

4010. Is not that a case where Bostock's glucose was supplied to an agent?—No; I have a case of that sort from a brewery. Dr. Campbell Brown alludes to two other makers.

4011. Is this particular German glucose of which you have told us used to your knowledge in Liverpool?—I could not say.

4012. Is the other sample of which Dr. Campbell Brown made mention the same as this you referred to?—I do not know. I only read his published report in the papers.

4013. Do you not know what the sample of glucose was with regard to which Dr. Campbell Brown made a report?—I do not.

4014. (Chairman.) Perhaps you would hand in the name and address of the breweries where you found the arsenicated German and American glucose in use?

—I will look them up, and will give you both names. I may also be able to send you some of the glucose.

4015. (Professor Thorpe.) Have you some of the glucose still in your possession?—I think I have; and I think I have some of the malt. I am not sure that I have some of the worst samples, but I have some of the malt that is bad.

4016. And what about the glucose?—And of the glucose as well. I have examined beers from Yorkshire, London, Burton, and Hampshire. In the London beer I found none; in three towns in Hampshire from which I obtained fourpenny beer I found not a trace; in one of the Yorkshire beers I found a quantity equal to what we had in Manchester; in the Burton beer I found a small quantity, 1-100th of a grain.

4017. (Chairman.) Did you find any contaminated Arsenic in caramel?—Nearly all caramel seems to be contaminated. I met with very few samples that were quite free; whether they were made from Bostock's sugar I cannot tell. I should say, however, that it was evidently from the same source.

4018. I understand from Dr. Thorpe that glucose which is off-colour is sometimes still further treated to make it into caramel?—Very probable. That might be the reason.

4019. (Professor Thorpe.) Are you able to tell us whose caramels they were, whose samples you examined?—I can ascertain the names, but I did not get them at the time.

4020. How did the caramels come into your possession?—From the breweries.

4021. Was there nothing on them to indicate whose make they were?—There was nothing on them except the name of the brewer. The majority of the samples came to me with the name of the brewer and the name of the substance.

4022. What quantities of arsenic have you found?—I have found large quantities.

4023. How do they compare with the amount of arsenic which you have found in the German glucose and Bostock's glucose?—I should think not more than one-seventh or one-eighth probably.

4024. Is the amount of arsenic you found in the caramel larger or smaller than the amount you found in Bostock's glucose?—Smaller.

4025. That would rather negative the supposition that this caramel had been derived from Bostock's glucose?—It would, from this particular glucose, but one does not know what the other glucoses may be.

4026. (Dr. Whitelegge.) Do you still find traces of arsenic in caramel?—I have not received any caramel yeast lately. The caramel, as one understands, is to replace the old burnt malt to colour the beer with. With respect to the yeast, in that particular brewery where I met with this German glucose I examined it, and then informed the Medical Officer on the 1st December that arsenic was found in the yeast in considerable quantities. Since then I have had 23 samples of yeast, representing nearly all the Manchester breweries. These yeasts are from a yeast merchant who is anxious to know when they are pure again. I found from 1-30th to 1-100th grain to the pound.

4027. (Professor Thorpe.) This yeast that you got from a yeast merchant may be an imported yeast, may it not?—No. He purchases the yeast from Manchester breweries, presses it, and sells it to distilleries, etc. In this case he was anxious to find out whether the arsenic was got rid of. It was practically got rid of by January 17th.

4028. Do you know anything about the origin of those yeasts?—I know, for instance, that in one case, the brewery I spoke of, where I discovered the arsenic in the yeast, they had received a store of yeast from Groves and Whitnall. They exchange when the yeast gets sick, and although it is worn out in one brewery it revives in another. I suppose it is the fresh soil.

4029. Groves and Whitnall have not used any of this German glucose to which you have referred, have they?—I presume they have not.

4030. But that is not the brewery that you are going to give us the name of?—No.

4031. Do you know whether the yeast to which you have referred was derived from this German glucose?—No. I understood from the brewer that he had purchased or obtained a new sort of yeast from a firm of

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obtained from brewers.

Arsenic in yeast.

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brewers where Bostock's sugar had been used, and he attributed the presence of arsenic in the yeast to that fact.

4032. (Chairman.) He had obtained it from Groves and Whitnall?—Yes.

4033. (Professor Thorpe.) Is the arsenic in the yeast in your opinion derived wholly through the intervention of Bostock's sugar; can you trace it back again to the use of Bostock's sugar?—In the majority of cases of yeasts submitted, I should say yes.

4034. The yeasts which you have examined have had their arsenic, in your opinion, derived from Bostock's sugar?—Yes; that is my opinion.

4035. (Chairman.) Will you proceed with your statement?—I have made a suggestion in view of the fact that there are very many differences between analysts, not only in the method and results, but in their way of treating the samples, that it would be advisable to form some committee which would deal with this question. I have had a letter from the Society of Chemical Industry, and they are forming a committee, and they have asked me to take part in formulating a method of dealing with arsenical samples, and the process of detecting arsenic. I may say that beneficial results were obtained from the Milk Committee, and that in the end the major portion of the analysts used one method in dealing with the milk. I submit that something like that is required in respect to arsenic.

4036. That there should be one uniform method of working and one uniform test?—Yes, one quantity, and that the quantity should be absolutely the same. The question also arises of making the standard accurate. I have suggested that the committee which deals with this should also make one standard solution, which should be sent down to every analyst, so that there should be no possibility of any difference even in the standards. I am not sure that all the standards taken by the analysts have been absolutely accurate—that is to say, they have made up solutions of arsenious acid. The standard is made up of a certain quantity of arsenious acid dissolved in water.

4037. A standard of what?—A standard of mirrors or of Reinsch's, or any process you want. You want a standard.

4038. (Professor Thorpe.) I think you had better explain rather more fully what you mean, because it is quite possible to determine the amount of arsenic irrespective of any such standard?—Quite so. I am talking of minute traces, which are all that exist now in beer. When you have to deal with small traces you cannot use a method of weighing, and therefore the method adopted in Manchester has been to make a solution of a certain amount of arsenious acid and analyse it, and produce a Reinsch sublimate or a Marsh mirror from it. It is not supposed or expected that we are going to work for weighable quantities. That there would be no difficulty about, but we are working for very minute quantities—that is, the quantities obtained from malt, I presume. The object would be to deal with minute quantities, not large quantities, which could be obtained by precipitation.

4039. Why do you make that restriction?—It is only a question of the initial amount of material taken, is it not?—Quite so. If you have gallons and 100th of a grain to a gallon you could get a weighable quantity, but commercially you cannot obtain a large sample. In the purchase of everything it is the same. You could not obtain a sample probably if you sent for an abnormal quantity. If the beer is sold in half-pint bottles the analyst may only get $3\frac{1}{2}$ ounces to analyse.

4040. (Chairman.) What would be the limit of quantity that you could obtain for a sample?—If you asked over the counter for a gallon of beer it would cause suspicion. The person who would go for it would generally be an inspector, and he would appear as a very unlikely person to carry a gallon of beer away, and it would be refused. There is no penalty for refusal compared with the penalty for adulteration. There is only a £10 limit for a refusal, therefore it is cheaper to refuse to sell than it is to be fined for selling. That is why our inspectors have to take special precautions in obtaining samples, because they may be refused.

4041. (Professor Thorpe.) Does not that rather point to a defect in the Act?—I agree with you there. It was suggested years ago that the penalty for refusal should be greater than the penalty for adulteration, but in the last Act it was not changed, notwithstanding the feeling of our committee. It is still £10 for one offence and £20 for the other.

Need for a
standard
test for
arsenic.

Sample
demanded
for Public
Analysis
must not be
too large.

Retailer
may refuse
to supply.

4042. (Chairman.) Apart from that difficulty of sale being refused for the purpose of analysis, there would be no practical difficulty in taking, say, a gallon as the quantity which should be taken for analytical purposes, would there?—Apart from that there would be no difficulty.

4043. You think that if you could have a standardised solution, from which comparative tests could be made, that would do away with some of the great discrepancies which now exist in the analysis of some beers?—That is so, granted that the method and the quantity are identical.

4044. (Dr. Whitelegge.) You do not agree with what a former witness told us, that this ought to be left to the discretion of the public analyst?—The public analyst would probably, if he were assisted by Somerset House, devise some method which is uniform; but it can be done at once if the Commission suggested it.

4045. But you think that all public analysts ought to be called upon to conform to an official method for analysis?—I do, undoubtedly.

4046. (Chairman.) You mentioned that at Blackburn the Medical Officer of Health at once obtained samples of beer from the incriminated brewery, and after analysis of the samples ordered the brewer to destroy all the beer brewed with Bostock's glucose, and left the inspector to see this done. Had he power to do that?—No, he had no power to do that. I heard that given in evidence in the case of *Holden v. Bostock*, in which £1,800 was given as damages.

4047. The beer was destroyed through the goodwill of the brewer?—I grant that; but my view is—and the Officer of Health for Blackburn thought the same—that you can ask the brewer to say which beers are the ones which are not brewed with Bostock's. You then sample those beers, and upon his word you would take them. If, upon analysis, you found them to be wrong, then you would have an opportunity for an action; but in the case of this arsenical scare it appeared to me that all the brewers were quite willing to accept the situation, and would, had they been pressed by any of the authorities, have destroyed all their beer before an official, so that the Corporation would have had the credit of having done something in this direction.

4048. You go on to say that you did not know that the Liverpool authorities ever destroyed the poisoned glucose at the manufacturers, but they certainly had the power to do so?—That is a power under the Public Health Act—on analysis, and discovering that it contained arsenic, and was to be used for food. The amending Act of 1890 covers all that. The first Act restricted the articles you shall deal with, while the amending Act includes everything that can be used for food—that is the 1890 Act, and it gives power to destroy deteriorated food as you might tinned meat or arsenicated flour, if you can imagine such a case.

4049. Would that give you the power to destroy glucose before it had entered into the composition of a food?—Certainly—anything intended for food. Glucose is practically a food of itself. The glucose itself might be made a food.

4050. But would you actually consider glucose as a food?—Take the case of flour. I would consider glucose as much a food as flour. Flour is not eatable unless there is some change, that is, until it is cooked. In the same way glucose would not be, until it is made into a sweet. But, at the same time, it is evidently covered by the Act.

4051. (Dr. Whitelegge.) Are not those further powers under the Public Health Act Amendment Act adoptive?—There was an opportunity of using them here, but no authority apparently has attempted it. The reason is this, that you might find on analysis of a beer that one particular barrel is arsenicated; but the question is, how dare you seize those other barrels? Because you do not know that they contain arsenic; you have only analysed one. It would be a cause for law suits and a claim for damages against the authorities. In this case I say there would not be an atom of difficulty owing to the feeling of the brewers upon the subject.

4052. Because of the amending Act?—The amending Act enables them to do it. You can point out the very thing. Bostock's sugar enables them to point it out, because the brewer's books would show in which brew it was used.

* Note by Witness.—I find Bostock's works are not within the City of Liverpool, so that the above remarks should not apply to Liverpool.

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destroy
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Mr. Estcourt. 4053. The amending Act gives certain powers?—Yes.
 4054. Those powers do not come into effect in any locality until the local authority has deliberately adopted that Act; is not that so?—I did not read that, but it may be so.

4055. Do you know whether that Act has been adopted in Blackburn and Liverpool?—I do not know.

4056. Or in Garston?—I cannot speak to that.

4057. (Professor Thorpe.) Has it been adopted here?—The original Act has been adopted here.

4058. (Dr. Whitelegge.) I am speaking now of the Public Health Acts. The original Act would not want adoption; but the amending Act does?—I see what you mean.

4059. Do you suggest if the adoptive Act is enforced that the medical officer of health would have power to go to the brewery to ask the brewer to distinguish those likely to be contaminated from those not likely to be contaminated, and then to take a sample for analysis?—He might take a sample for analysis eventually.

4060. And then take no further action until he received the result of the analysis?—He could ask them to point out the contaminated barrels. As I say, the mood of the brewers was such that they would have done it at once. I do not say that it would have been successful ordinarily, but in this case it would have been the easiest method of dealing with it.

4061. Even if the adoption of the Act were enforced locally, it would not give a medical officer of health power to deal with an emergency unless the brewer gave him the facility?—That is so; but that drawback applies to all foods. It might apply to flour or any food you like. If you have a suspicion that flour is adulterated, and the miller or the large flour dealer is at fault, you analyse a sample, but you cannot seize the rest without information from him.

4062. Has it to your knowledge been the practice to seize large quantities of food supplies of any kind after an analysis of samples? Has not the action taken by local authorities in condemning large quantities of food supplied been limited to those cases where they were determined to be bad by the inspector?—I will take the case of tinned meats. There are some cases—take, for instance, what is called the blown tin—where it is quite feasible that some decomposition has set in. I read a case the other day where they had actually bored these tins at the Stores to allow the gas to escape, and then sealed them up again. Yet those were seized.

4063. On analysis?—I cannot say on analysis; I suppose on opening one of them.

4064. That is by inspection, not analysis?—Yes.

4065. The suggestion is that beer or any other substance dangerous in a large quantity, which could only be proved to be dangerous by analysis, should be seized after analysis; that is a suggestion, and not a record of experience?—It is simply a suggestion. As I say, the difficulty in the Act applies to every food.

4066. (Chairman.) As a matter of fact, no Bostock's sugar was sold or sent out from Bostock's after the first suspicion that their sugar was connected with arsenicated beer?—I understand from the evidence, not.

4067. So that really the non-action of the Liverpool authorities, which you have stated to us, had no effect with regard to Bostock's?—One cannot tell. They say that none went to the brewers—that is their evidence—and that they received large quantities back from the brewers. But what was done with it no one appears to know.

4068. What you would wish us to infer is, that at present nobody knows what has become of Bostock's stocks?—Yes, whether it has been destroyed by them or not.

4069. (Professor Thorpe.) No one officially knows?—That is what I mean.

4070. (Chairman.) Then you go on to speak of a case in which beer containing 1/4th grain of arsenic per gallon was sold as late as the 2nd January?—Beer containing 1/4th grain was sold as late as the 2nd January, or six weeks after the discovery of arsenic in beer. I say if action had been taken, however improperly, under the Act, as was done at Blackburn, that could not have occurred.

4071. How did it occur that that beer was sold?—The brewers did not keep their promise.

4072. (Dr. Whitelegge.) Are you referring to a Bostock beer?—I think it was a North Cheshire brewery company. The case was reported in the paper on the 12th of this month. It is a brewery not very far from Manchester.

4073. Where was the prosecution?—I forget where it was, but I can supply you with a cutting. Not only is that the case, but in two of the towns for which I am analyst, on the 12th December beer was being sold containing 1/7th and 1/8th grain of arsenic respectively. You will see in the Manchester case that the last sale of beer containing a considerable quantity—1/8th of a grain—was on the 6th December; and after that they came down to what I presume were derived from malt, 1/50th and 1/100 of a grain. But on the 6th December there was one brewery in Manchester which sold beer containing 1/8th of a grain.

4074. Was that from one brewery or one house?—It was from one house. I have the name of the brewer. It is No. 2.

4075. (Chairman.) Might that have been an accident?—Yes. I am not suggesting anything more than that beer containing that amount of arsenic was being sold in two towns.

4076. (Professor Thorpe.) But have you any knowledge of this fact? We have had evidence from this particular brewery, and we have had evidence that everything to their knowledge was done to destroy the incriminated beer; and yet you tell us that so late as December 6th beer from that particular brewery was being sold?—It is not only the fact—I have certified it. The summons was issued with regard to that.

4077. Do you know the reason why this particular lot of beer escaped destruction?—I have no knowledge of anything about that. I could not even tell you where it came from. I know the brewer's name was given to me, but I have no knowledge whatever of the circumstances under which the sample was taken.

4078. (Dr. Whitelegge.) Are proceedings pending in that case?—I believe so. One of the other brewers—No. 3—was selling in one of these towns as late as December 12th, and that beer, I believe, contained 1/7th of a grain.

4079. (Chairman.) That would not be in Manchester?—No. It was in Lancaster. No. 3 I find did sell beer in Lancaster on the 12th December containing 1/7th of a grain.

4080. (Professor Thorpe.) How do you reconcile these two circumstances with your previous statement that to your knowledge the brewers were doing everything they could to destroy the beer?—This is an individual house from which samples were taken. I do not suggest that all the brewers' public houses contained arsenical beer. I have no knowledge of it at all.

4081. But this was taken from a tied house, was it not?—I cannot tell you. I know nothing about it, except that I had a sample, and on it was the name of the brewer.

4082. But not the name of the public house?—No.

4083. But the action was brought against the licensee of the public house?—I have nothing to do with that. I never know until I go into court against whom the prosecution is directed.

4084. (Chairman.) Have you any suggestions to make with regard to the prevention of such an occurrence again?—It does not appear that the Food and Drugs Act would have any value. At least ten days to a fortnight would elapse before a summons could be taken out, as the analyst's certificate goes before a committee, and then probably another fortnight before the hearing of the summons. During that time there is no inducement for the brewer to destroy the beer—none whatever; he can continue selling.

4085. As a matter of fact, the brewers acted very differently, and did destroy the beer, did they not?—There is no doubt about it in the cases which you have before you, but I do not know that that was the case in all instances.

4086. It is against their interests to destroy the beer?—Yes. In the case of Groves and Whitall they did destroy the beer, and I have no reason whatever to doubt that their claim against Bostock's shows the amount they did destroy. You may go so far as to say that some brewers were extremely scrupulous, but you cannot say

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F. and D. Acts insufficient to secure destruction of arsenical beer.

Mr. C. Estcourt, 26 Mar. 1901. that all were equally so, because you have the proof of its being sold as late as I say in one particular case as January 2nd.

4087. (Dr. Whitelegge.) But you do not infer that the example of Groves and Whitnall was not generally followed?—I hope it was.

4088. Have you any reason to believe that it was not?—None, except the evidence given here—that there was arsenicated beer sold afterwards. I do not suggest anything from that. It may have been an accident; it may have been a small quantity left in one house. But I do suggest that some better method should be invented to deal with this matter.

4089. (Chairman.) In the public interest in the future?—Yes. The brewers may and are from their position and from their large capital largely before the eyes of the public, and therefore it may be probable that they may have acted as Messrs. Groves and Whitnall did, and got rid of the whole of it; but you have the smaller manufacturers to deal with in the case of food, and the Sale of Food and Drugs Act does not help you a bit; it does not get rid of the poisoned food. As Dr. Thorpe mentioned, even if you had the power to get a sample from the brewer that power was limited apparently under the last Act, because it was suggested that it would be very unfair to grocers that inspectors should get samples of their stock from their carts, because it might destroy some customer's parcel. It was only permitted to take in transit with the consent of the retailer or the purchaser. That could have been done in this case, I daresay. I do not doubt that any of these tied houses would very gladly have consented to samples being taken from the barrels at the door when they were being delivered; but at the same time that rather puts a hindrance in the way of dealing with the brewer if consent of retailer must first be obtained.

4090. (Dr. Whitelegge.) But in any case the proceedings would be directed to the penalty and not to the destruction?—The penalties are very small. In the case I alluded to of January 2nd the penalty was much less than the total amount might have been.

4091. (Chairman.) Therefore your suggestion would be that the Food and Drugs Act should be remodelled or improved?—No, the Public Health Act. I say it appears to be unworkable. If you have a large flour dealer with a stock of flour—and there have been cases known of arsenic in flour, ages ago—that if you find one sack sent out containing arsenic, and you went to the flour dealer, you could not seize his stock because you would have to analyse each sack separately. The Act is unworkable. I cannot suggest how to make it workable, except that you could put an embargo on the whole of the deleterious food if one sample was found to be wrong, and not allow any stock to be sold until it had been ascertained which sacks were free and which were found to contain arsenic. That is the only way in which the Act could be made workable.

4092. (Dr. Whitelegge.) Would that be workable in the case of a large factory?—I think so. It would be in the case of a brewery, that is certain. The whole of the brews are stacked up and every cask marked with the date and every detail. Every cask could be identified. They could say: "That pile there of 1,000 barrels was brewed with Bostock's sugar, and that one is free."

4093. Do you suggest that the local authority or their officers should have power to go into the brewery or on to a manufacturer's premises and lay an embargo upon such goods as they thought, pending analysis?—Yes.

4094. And you would allow a fortnight for the analysis?—No, not necessarily. A day would do.

4095. But in the case of proceedings under the Sale of Food and Drugs Act, we were given to understand that a fortnight must elapse before you could lay an information?—No, some of them were laid in seven days; but by the 1899 Act they cannot take place until 14 days from service of summons. I may say that when I certified I had not the faintest idea that action would be taken under the Sale of Food and Drugs Act, having the view that we were not the proper officers to take notice of accidental contamination. I had not the faintest idea. I was asked to certify, and I certified.

4096. (Professor Thorpe.) You quoted, as an example of what you suggest should be done, the precedent of the Committee of the Society of Public Analysts in the case of milk?—Yes.

4097. That was, I suppose, when you took over what you called the standard method?—That is so.

4098. The Adams' process?—Yes.

4099. Do you suggest, as the result of such action, that what did actually happen in the case of milk should also happen in the case of arsenic?—You have the power to recommend that a certain method should be adopted. We had no such power.

4100. As the result of the action of your committee, you put your heads together and officially adopted what is known as the Adams' coil process?—Yes.

4101-2. And almost immediately after that all of you did not use it?—I cannot say that. A great many used it. For instance, I used it in the case of adulterated samples.

4103. Do you use it now?—I do.

4104. Is that process generally in use by the analytical profession?—I should think so, for adulterated samples. When you get a sample you can ascertain by the Wanklyn process practically whether it is a fairly good milk or adulterated. To determine the amount of adulteration you must use this method. I use it.

4105. Do you know any other analysts who use it?—I think Hehner uses it.

4106. Have you read the report of the Committee on Milk Standards?—I have only read a portion of it.

4107. You have not yet read the evidence?—I have got the evidence, but I have not read it all.

4108. Have you got as far as the evidence which shows that practically scarcely any analysts use the Adams' coil process?—I have not noticed that.

4109. The President of the Society of Public Analysts does not use it, the Vice-President does not use it, the honorary secretaries do not use it; practically few officers connected with the Society of Public Analysts uses the official method. Do you think your suggestion that the Society of Public Analysts should now meet together and prescribe an official method, is likely to be more successful in the case of arsenic than in the case of milk?—I am suggesting that you would probably endorse the views of the committee if they submitted them to you. I am suggesting that this should be made an official standard. I daresay that the Society of Public Analysts would find very efficient men; but, at any rate, it must be made absolutely official, in order that it may be of any value at all.

4110. I concur in the principle of your suggestion, but, unfortunately, your illustration is not quite fortunate?—The fault is because it was not made official by the Government. That is all.

4111. (Dr. Whitelegge.) What form of certificate do you use?—There is a modified form. You may recollect probably that the mere expression of opinion of the analyst as to the amount of water was accepted, but that was upset. It is a decision of the High Court. The form that the Society of Public Analysts desire should be used, and which I have been using recently, is: "This milk is composed of 90 parts of milk and 10 parts of water." This opinion I base upon the fact that the solids not fat are so much instead of so much—that is 8.5; and by a simple calculation of these figures you can make out this as 10 per cent.

4112. What form of certificate would you use in the case of beer? If you certified beer as containing arsenic, in what terms would you certify?—"I certify that this beer contains not less than one-eighth of a grain of arsenious acid per gallon."

4113. In what terms would you report to the authority who furnished you a sample of beer, if you found it practically free from arsenic?—I have made several reports recently. On the 15th December I wrote to the Corporation describing my discovery of large quantities of arsenic in malt. Since then I believe they have modified their view as to the quantity with regard to which they should take out summonses. They were taking out summonses for one-hundredth of a grain per gallon. I have nothing to do with the taking out of summonses myself, but I should not advise taking out summonses in cases in which there was less than one-thirtieth of a grain.

4114. You have not advised the Corporation, I believe, for the last four years?—Practically no. For 24 years a committee which had the word analyst attached to it sat, and I met them at stated inter-

Samples in transit can be taken, but consent of purchaser necessary.

Power under P. H. Acts desirable to restrain sale pending analysis desirable.

Standard tests for arsenic should be official.

Mr. C. Estcourt, 26 Mar.

Form of P. A.'s certificate

Quantity of arsenic in beer which should be prosecuted

vals. For the last four years that name has been left out, and there is no Analyst Committee, and, as a consequence, I never met them. Some of the committee which deals with my certificate, I presume, do not know me at all.

4115. You have not given us the form of the certificate you use in a case in which you came to the conclusion that one-hundredth of a grain of arsenic per gallon was present in the sample?—I write and say number so-and-so contains simply a trace of arsenic, or contains less than one-fiftieth of a grain. I understand that the Corporation are not taking action in cases of less than one-fiftieth of a grain, so that I simply report the presence of arsenic in these samples to the extent of one-fiftieth, or one-hundredth of a grain, or whatever it might be, without certifying.

4116. And when you do not think a case is one for prosecution you use the expression "less than"?—I do not certify then.

4117. You make a report without certifying?—Yes.

4118. (Professor Thorpe.) When you say they are not taking action in cases above a certain limit who has been the authority to guide them? How have they arrived at this limiting value on which action should be taken?—I should imagine the Town Clerk advised them. My suggestion was to some extent taken, but not the limit I gave. I said that action should be taken in the case of all samples where the contamination was more than one-fiftieth of a grain per gallon. I believe that of all samples of beer which derive their arsenic from the malt none contain more than one-fiftieth.

4119. (Dr. Whitelegge.) But over one-fiftieth?—I considered it was attributable to Bostock's glucose, and in my suggestion of the 15th or the 17th December I said that if they took proceedings under the Sale of Food and Drugs Act they should not take out summonses against retailers whose samples showed less than that amount.

4120. Do you consider 1-15th of a grain harmful?—I am not a medical man, but I think it is too much to have in beer.

4121. You said that if you were advising you would advise that no prosecution be instituted for less than 1-30th?—Yes.

4122. Is that because you think that arsenic at the rate of 1-30th of a grain per gallon could not be harmful to anybody?—No. The reason is because it is due to the malt, and I know that you cannot eliminate it from the malt. It may take some time before maltsters will institute a new process which will do away with arsenic in malt, and therefore as a practicable quantity I have suggested that amount.

4123. (Professor Thorpe.) I should have thought that a few prosecutions would have considerably accelerated the rate at which the change would take place?—The

change is a tremendous one, but it is not so great as I thought. I have received this morning a description of the pneumatic development of the malting system. The malting system was a very crude and rough method of old, simply wetting some barley, throwing it on the floor, and moving it about in various degrees of thickness by men by rule of thumb. Since then a very elaborate process has been devised of making malt in cylinders. But in this method, if they used the coke they used formerly, it would increase the quantity of arsenic in the malt enormously. Instead of beginning the process by putting the malt on the floor after it has been steeped they now begin it by drying it in these cylinders, through which the fumes are driven. So that they begin to arsenicate the malt seven or eight days before it would be arsenicated in the ordinary kiln. Surely if they could afford an elaborate process like this—an entire change in the malting process—they could afford the very little that is necessary for drying in cylinders, without allowing the fumes to come into contact with the malt at all. I may mention that a brewer visited me the other day in consequence of my having found a small quantity—1-35th of a grain—in his beer. He said he had used no Bostock's glucose, and that he was certain his malt was free. I said to him, "When did you make your stock of malt?" He is a maltster as well as a brewer in Lancashire. He said, "We might have some of the old coke-dried malt left." I said, "Do you see any difficulty yourself in devising a method of drying the malt without allowing the fumes to come into contact with it at all?" and he said, "I do not." I said, "Why should not you be the first to do it?" This was the managing director of the company, and he said, "We intend to do it. We are going to dry the malt without the fumes coming into contact with it at all." A large malthouse has been put up here recently, within the last three or four years, but they have made absolutely no change from the old method except that when the malt is ready to be put upon the kiln it is carried up on elevators. That is the only change that I have seen in 40 years in the manufacture of malt. The place I have mentioned is a very fine new building, in which all the modern improvements could be made.

4124. (Dr. Whitelegge.) Have you examined many malts recently—within the last few weeks?—Up to about the 17th or 18th December I examined 74 samples of malt, but I do not think I have examined any since then.

4125. Then you cannot say whether you have found recently that the malts have been free from arsenic?—I cannot, but the beer brewed is not yet free.

4126. We have been told that it is the practice of some brewers to require a certificate of the malt being free from arsenic?—As an example of that, I might say that this gentleman whose malt contained so much arsenic told the brewer in my presence, "I do not care; I will guarantee it to you." So certain was he that it did not contain arsenic that he said he would guarantee it. But of the value of a guarantee of that sort one can judge.

Mr.
C. Estcourt.
26 Mar. 1901.

Malt should be dried without contact with fumes.

Small value of guarantees

Mr. EDWARD SERGEANT, called; and Examined.

Mr. Sergeant. 4127. (Chairman.) You are a Member of the Royal College of Surgeons, a Licentiate of the Royal College of Physicians, and Medical Officer of Health to the Lancashire County Council?—That is so.

4128. I think you would like to make a statement with regard to your district and with regard to your duties in connection with the office you hold from the Lancashire County Council?—The Administrative County of Lancaster, in the middle of last year, had an area of 1,098,269 acres, and a population estimated at 1,956,555. Within the county are 138 districts, including 20 municipal boroughs, 99 urban districts, and 19 rural districts. The whole of these districts, with the exception of the Boroughs of Accrington, Ashton-under-Lyne, Bacup, Blackpool, Clitheroe, Lancaster, Southport, and Warrington, are under the jurisdiction of the County Police, and the Superintendents of the various Police Divisions, 20 in number, are appointed inspectors under the sale of Food and Drugs Act for the purchase of samples for the purpose of analysis by the County Analysts, Dr. Campbell Brown and Mr. Collingwood Williams. The local authorities occasionally exercise their powers in purchasing samples of food for analysis, but as a rule this work is left entirely in the hands of the police. When the prevalence of arsenical poisoning among beer-drinkers was first re-

cognised, Colonel Moorsom, Chief Constable of Lancashire, kindly permitted me to direct, through him, the purchase of beer samples, and the action to be taken on the discovery of contamination by the analysts. On the 23rd of November last my attention was specially drawn to the public danger by the statement which appeared in the press concerning the alarming prevalence among persons who drank beer in Manchester and Salford of symptoms of peripheral neuritis attributable to arsenic. The communication to the "British Medical Journal," November 24th, by Dr. Reynolds, as to the large number of cases which had been observed by him and several other medical men, left no doubt as to the serious nature of the epidemic. It did not take long to discover that in the County Districts of Lancashire many patients were suffering from symptoms of arsenical poisoning, due to the consumption of beer supplied by large brewers both outside and within the jurisdiction of the County Council; the prevalence of sickness and the severity of the symptoms being largely influenced by the amount of arsenic discoverable in the beers supplied to the consumers in the various localities. With few exceptions, only those beers were seriously affected in which the invert sugar manufactured by the well-known Liverpool firm (Messrs. Bostock and Co., Limited) had been used in

Mr.
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Quantities
of arsenic in
incriminated
beer.

the brewing, and the extent of the contamination varied considerably according to the proportion of this material to the malt of the brew. The amount of arsenic, in the form of arsenious acid or what is known as white arsenic, found to be present in the samples of beer submitted to the County Analysts, was certified as incapable of exact estimation in 50, and in 47 it varied from 1-15th to $\frac{3}{4}$ grain per gallon. In one instance a sample of beer analysed by the Clinical Research Association showed the presence of 1-12 grains of arsenious acid per gallon, and this beer was productive of very marked symptoms of peripheral neuritis among the consumers. One death resulted, and subsequent examination of some of the viscera by Dr. Campbell Brown demonstrated the existence of arsenic in considerable quantities in the liver, spleen, and kidneys. Altogether 348 samples of beer supplied to retail houses from 175 breweries have been purchased, with the result given below:—

	Number of Breweries.	Number of Samples taken.
Breweries supplying genuine beer	108	251
Breweries supplying beer slightly arsenicated, but passable	36	52*
Breweries supplying beer containing an amount of arsenic injurious to health	31	45
Total	175	348

The samples taken from "free houses" numbered 58; of these, 46 were found to be genuine, 8 slightly arsenicated but passable, and 4 contained an injurious amount of arsenic. Without exception, these contaminated beers had been obtained from outside brewers, and in no case was arsenic discovered in "home-brewed" beer. The police on the 27th of November commenced to take samples of beer in the various county divisions, and Table 1 appended shows that from that date to December 3rd inclusive 75 preliminary samples were taken, and 18, or 24 per cent., were found to contain arsenic to a serious extent. The information gained by the examination of these samples proved valuable; no legal action, however, resulted, as it was considered only fair to give brewers a reasonable time for taking precautions against the use of brewing materials in any way contaminated. From December 3rd to the end of February the police purchased 273 samples of beer for analysis, and of these 27, or 9.8 per cent., have been certified by the county analysts as seriously contaminated, that is, containing not less than a tenth of a grain of arsenic per gallon. In 24 instances prosecutions were instituted under section 6 of the Sale of Food and Drugs Act, 1875 (see Table I.), with the following results, viz.:—15 fines inflicted, varying from 20s. to £5, with costs; 4 adjourned, 2 withdrawn, and 3 dismissed. In explanation of the method of procedure adopted I may mention that on samples being submitted to the county analysts they first made a preliminary examination, and on the detection of arsenic in any sample they at once notified the police by wire; information was then conveyed to the beer-seller, who on his part communicated with the brewer, and further sale of the implicated beer was discontinued by sealing up the remaining barrels of the same brew found on the premises until complete analysis had been obtained. When an appreciable quantity of arsenic was finally certified the contents of the sealed barrels were promptly destroyed, and it is satisfactory to observe that no objection was raised to this drastic course of action, although in many instances legal proceedings were subsequently taken. The beers certified by the county analysts as "passable" were unsealed and allowed to be sold. During the period under notice, i.e., November 27th to February 29th, the officials of the county either directly or indirectly secured the destruction of arsenicated beer contained

Prosecution
under Sale of
F. and D.
Act.

Destruction
of arsenical
beer.

* Of the 52 samples certified as slightly arsenicated but passable, in 50 the amount of arsenic was incapable of estimation. Subsequent examination showed the presence of 1-15th of a grain of arsenic per gallon in two samples; the beer was destroyed in both instances, but no prosecution followed.

in 5,313 $\frac{1}{2}$ thirty-six gallon barrels, 22,680 pint and 12,395 half-pint bottles. Besides the above, a large quantity of beer was destroyed by brewers privately, and the bulk of beer contaminated to an appreciable degree was, in the course of a few days after the commencement of our action, removed from the possibility of sale.

In the early days of the beer scare the cause of contamination was chiefly attributed to the use of arsenicated glucose, and, although this source of trouble subsided, yet samples of beer known to be brewed from malt and hops only came under notice containing arsenic equivalent to 1-10th to 1-5th of a grain per gallon. Investigations carried out by chemists interested in this question soon showed that serious arsenical contamination could arise from imperfectly brushed malt as well as from yeast rendered impure during its growth. These views are now admitted by the brewers, and it is satisfactory to state that, subsequent to the 14th of last January, no case of contamination has come under notice sufficiently serious to give rise to legal action, although from that date to the end of February 101 samples were submitted to analysis. I think I shall have rather to alter my statement, because yesterday I received a letter from the public analyst, Dr. Campbell Brown, saying that he had found two other samples containing arsenic to a sufficient extent to indicate that a prosecution should take place. These samples were obtained on the 11th March. Having now got rid of beer recognised as distinctly dangerous in character the next point for consideration will be the action to be taken by sanitary authorities in regard to the sale of beer only slightly arsenicated. In my opinion it would be unsafe to allow the consumption of beer containing an amount of arsenic capable of estimation by the analyst. If it is a fact that the presence of arsenic is due to avoidable impurities which can be kept out of beer I see no reason why absolute purity should not be required. This position is already admitted by numerous brewers, who do not hesitate to freely advertise the purity of their beers. Unfortunately, some of these advertisements have proved misleading to the public, and the various methods of testing adopted by analysts have contributed to this result. It would be well, therefore, if analysts, with the assistance of Somerset House, could devise a recognised procedure for estimating the amount of arsenic in beer, and so avoid the conflicting want of agreement not uncommonly met with. It is extremely difficult to estimate with any degree of precision the amount of injury to health caused in this county by the consumption of poisoned beer. No doubt for some months before the symptoms of arsenical poisoning in beer drinkers were fully recognised in Manchester and Salford obscure cases, similar in character, not infrequently ending in death, were troubling medical men in various parts of the county. The earliest cases that have been made known to me are those referred to in a special report by Dr. Hitchon, Medical Officer of Health for Heywood, as occurring directly after Whitsuntide of last year. He also says that one was struck by the very unusual number of persons, especially men, who "were suffering from skin affections of the feet and hands; the feet and hands were red, swollen, and painful." The earliest death that I am aware of took place in the Wigan Infirmary, August 16th last, and is reported by Dr. Hannah, Medical Officer of Health, as having reference to a female who had been removed from his district (Ashton-in-Makerfield) on the recommendation of the private medical attendant (Dr. Latham). I have the reports here.

The communications received from medical officers of health show that in 37 of the total 138 districts within the Administrative County cases of arsenical poisoning have been observed, and information is given of 953 cases and 15 deaths, including 7 certified by the coroner after inquest. These do not, in my opinion, fully represent the total cases of poisoning in the county, and the wide variations in the district distribution as indicated by the returns are largely dependent on the views held by the local medical practitioners on the subject of beer poisoning. From my own investigations I feel justified in saying that many deaths from arsenical poisoning during the last half of 1900 have been registered as due to alcoholism, locomotor ataxy, Addison's disease, spinal sclerosis, disease of the liver, etc. This view I also give as explaining to some extent the great increase of deaths from causes largely dependent on alcohol which have occurred in the county during the six months ending December 31st last year, as

Mr.
E. Sergeant.
26 Mar. 1

Arsenic in
all-malt

Difficult
administra-
tion when
minute quantities
found in beer.

Epidemic
noticed at
Heywood
before can
ascertain

Number
persons a-
ttacked du-
ring epidemic.

Fatality.

Mr. compared with the corresponding six months of 1899.
Sergeant. See table below:—

Mar. 1901.

Returns from 124 of the Districts within the Administrative County.	Alcoholic Neuritis.	Peripheral Neuritis.	Multiple Neuritis.	Alcoholism.	Any other allied Diseases.	Total.
Deaths during Six Months:						
June to December 1900	4	14	5	54	41	118
June to December 1899	0	4	2	24	32	62
Increase in 1900	4	10	3	30	9	56

The allied diseases are sclerosis and sundry others of that character, Addison's disease and so on, that were known by local medical practitioners as dependent largely on the consumption of beer, and probably due to arsenical poisoning. The total increase is 56. I have here, sir, the list of places where these have been returned from, and I have also spot maps, which show how they have been distributed. As illustrating the effect of highly arsenicated beer on the health of the consumer, I may mention the case of a brewer who on the 7th and 19th of September, 1900, was supplied with English glucose (Bostock's) in lieu of American glucose he had contracted for. The beers in which the English glucose had been used in the brewing were found to contain at least one grain of arsenic per gallon, and soon after delivery to the retail houses, about the third week in September, symptoms of arsenical poisoning occurred among the consumers. I am informed that frequently persons who drank from two to three pints of beer were attacked on the same day with nausea, vomiting, and diarrhoea, followed in one case by hæmatemesis. The more marked symptoms of arsenical neuritis appeared from the first week of October to the end of November, and I have had the opportunity of examining several of these cases. One man, whose illness commenced on the 13th of October, died on the 30th of November from decided arsenical poisoning.

I say from decided arsenical poisoning, because I attended the inquest, and with the private medical practitioner assisted in sending in sealed bottles the portions of the various viscera. Subsequently to that Dr. Campbell Brown, who examined them, discovered distinct traces of arsenic in various organs, so that there is no doubt as to that. I may also say that it was at first registered as locomotor ataxy, and subsequently the medical practitioner and I reported the death to the Coroner. It is one case of, I believe, many that have been returned as not due to the true cause. Of course, in this case it was not owing to any desire to cover up the cause of death, but simply to an error of diagnosis which might occur of course in any man's practice, in the early cases. Except in this fatal case the drinking of beer ceased, on the advice of the medical attendants, when serious symptoms developed. At the present time I understand that 50 per cent. of the persons attacked still suffer from the effects of the poisoning, and, with few exceptions, those who have returned to work still complain of nervousness, debility, and cardiac troubles. The men that I examined usually drank from two to four pints of beer daily, with an extra allowance towards the end of the week. Three females, whose beer consumption did not exceed one pint daily, came under notice, suffering from arsenical symptoms; in one case not more than half this amount of beer was consumed, and I calculate that the dose of arsenic taken would be equivalent to 1-20th of a grain per diem. It suggested to my mind that certain individuals, more particularly females, have shown an extreme susceptibility to the action of arsenic when taken in beer. Whether this is the full explanation, future investigations will decide. I may say that I have got a cask of the beer. If you at any time would like to have the beer for any further investigation I shall be very glad to send it you. This is the worst beer I have come across—the beer that I have spoken of as being so poisonous.

4129. The beer that had 1-12 grains per gallon?—Yes. It has been variously estimated at from one grain to 1-12, and even more than that. I may mention that 55 samples of jams, marmalade, and other sweets have been specially analysed by the county analysts, and none of these contained any arsenic. Quite recently 20

4576.

samples of baking yeast were analysed, and the county analysts report that, with possibly one exception, every one of the samples contained an exceedingly small trace of arsenic.

4130. (Professor Thorpe.) Were the samples English yeasts?—They were taken indiscriminately. They were the ordinary yeasts purchased in shops for baking purposes. They would be like the yeasts that are called German yeasts—yeasts that are imported, and the ordinary yeasts that are sold in shops, the dry yeasts that you purchase.

4131. But you could get particulars no doubt?—Yes, we could get particulars.

4132. From your analyst?—I do not know that he would have any description beyond the particulars of the purchase, and the sample. I do not know that they would be able to say where they came from. They were purchased from small shopkeepers.

4133. Would they be known to be beer yeasts, or not?—I have inquired into that. I could not say that they were all beer yeasts. It was simply the fact that we got baking yeasts. They have been somewhat recently taken, and seeing that the trace of arsenic was so minute we have not considered it really desirable to go much further into the matter. We do not consider it is at all detrimental to health. It is simply a fact that these yeasts do contain a very minute trace of arsenic.

4134. You are aware, of course, that a very large proportion of imported yeast is derived from Dutch distilleries?—Yes.

4135. (Chairman.) You have not at the present moment any means of connecting these purchased yeasts with special breweries?—No. I do not think that they came from special breweries. It is simply that it occurred to us that the yeast might be contaminated, and that it would be interesting really to know the extent of the contamination in the same way that, as I mention further, we had under consideration certain non-alcoholic drinks. We have reason to believe that ginger beer, for instance, has proved dangerous to health, in consequence of the highly arsenicated yeasts which have been used in its manufacture. In fact, it has been stated to me by a gentleman, who has been very interested in this matter, and who made considerable investigations, that that is the explanation of symptoms of arsenical neuritis, that have appeared in a total abstainer who largely drank ginger beer.

4136. Therefore that ginger beer, which seems to have produced the symptoms you speak of, was made from local yeast?—That is so, and highly contaminated yeast. In the manufacture of the beer, Bostock's sugar had been used to the extent of 45 per cent. of the malt.

4137. And perhaps Bostock's materials had been further used in the manufacture of the ginger beer?—Well, I do not know that. I should not go so far as that. I am not aware that Bostock's sugar has been used in the manufacture of these non-alcoholic drinks.

4138. (Dr. Whitelegge.) Have you any analytical results with regard to this ginger-beer or the yeast?—No, I have not. It is simply a suspicion. We could not get that special ginger-beer. The explanation was given after some considerable thought, and it struck me that there was a substance of truth about it, or possible truth, and it showed the desirability of examining further into the non-alcoholic drinks. Beyond that I cannot go. In order to avoid a repetition of wholesale poisoning such as we have recently witnessed, it seems to me desirable that more attention should be paid to the carrying out of the Sale of Food and Drugs Acts which, in some respects, require amendment. All places used for the preparation of foods or drinks should be open to the inspection of the officers of the Sanitary Authority in whose district they may be established, and it should be competent for an officer to remove for the purpose of analysis any article used in the various operations carried on. Brewers should be required to declare on the entry sheet for the Excise the whole of the materials employed in the manufacture of their beers, and it should be incumbent on the proper officer of the Inland Revenue to have frequent analyses made of the various brewing materials in view of his action to obtain the absolute purity of the beer. I do not suggest that in the manufacture of beer the use of glucose to a moderate extent, say from 2 to 10 per cent. of its equivalent in malt is undesirable, but there is reason to believe that the use of from 35 to 45 per cent.

Mr. E. Sergeant.
26 Mar. 1901.

Arsonic in yeast,

might contaminate ginger-beer.

Excise should know origin of brewing materials, which should be officially tested.

Mr.
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of this material renders the beer less wholesome and more likely to produce dyspepsia and gastric disturbance. Some medical men attribute much sickness to the consumption of immature beers brewed one week and sold the next, and would prefer a malt and hop beer that has been fully matured. I have here the table which I have referred to, giving you the whole of the details. I may say that of the 60 samples of glucose which were examined 53 were found free from arsenic, and 7 were found containing arsenic. Four samples were found to be Bostock's and three samples were obtained from another firm. The name is there (*document handed to Chairman*), but perhaps it is not desirable to mention it because I do not know the amount of contamination. It may be of German manufacture, and it may be one that Mr. Estcourt spoke of.

Arsenic in
German
glucose.

4139. (*Professor Thorpe.*) Do you know the name?

(*Chairman.*) Yes, it is the name that Mr. Estcourt gave.

4140. (*Professor Thorpe.*) Do you know whether that German glucose is much used in your district?—I do not think that that is very much used, but I really cannot speak of that.

4141. Has it been long introduced, do you know? Can you give us any particulars?—I cannot say. I cannot give you any particulars. These samples were obtained by the superintendent indiscriminately.

4142. Is the amount of arsenic in that particular glucose given in your tables?—No, the amount is not given. I do not think it is given in the case of Bostock's either. These were simply preliminary examinations that were made to assist brewers, and the statement was made by the public analyst that the sample was either free from arsenic or contained arsenic, but the amount was not estimated.

Arsenic in
beers not
brewed from
Bostock
sugar.

4143. (*Chairman.*) You say "With few exceptions only those beers were seriously affected in which invert sugar manufactured by the well-known Liverpool firm (Messrs. Bostock and Co., Ltd.) had been used in the brewing." There were exceptions, then?—Yes. There were exceptions. I have here the particulars of the cases where we proceeded. Of the 24 cases, in 10 Bostock's sugar was used. The cases where the brewers had previously used Bostock's sugar but did not do so in the brew in question number seven, and glucose was obtained from another individual in one case. Whether he obtained it from Bostock's I do not know. I give the name here. Then we had six prosecutions where the beer was brewed from malt and hops only, and we have no history as to whether the brewers previously had used Bostock's glucose.

4144. Have you got an estimate of the amount of arsenic in those that were brewed from malt and hops only?—Yes, I have got particulars of the arsenic found in each estimation.

Quantities.

4145. Will you indicate which are those?—In the cases where Bostock's glucose was used the public analyst found three-fourths of a grain, two-thirds of a grain, two-thirds of a grain, $\frac{1}{2}$ of a grain, $\frac{1}{2}$ of a grain, two-sevenths of a grain, one-ninth of a grain, one-ninth of a grain, one-ninth of a grain, and one-seventh of a grain. Then in the samples not containing Bostock's glucose, but brewed by people who had previously used Bostock's glucose, the amount of arsenic was as follows: $\frac{1}{2}$ of a grain, $\frac{1}{2}$ of a grain, one-fifth of a grain, one-sixth of a grain, one-sixth of a grain, one-seventh of a grain, and one-tenth of a grain. Of course we could not prove that they had not used some of Bostock's sugar, but at any rate that is the information we obtained. Then with respect to the glucose purchased from the person in Shudehill, Manchester—he does not manufacture it, and where he got it I do not know. It is possible he got it from Bostock's; in that case there was found one-fifth of a grain in the beer. Then in the beer brewed from malt and hops only, of the 6 samples one contained one-fifth of a grain, another one-seventh of a grain, and the others, one-eighth of a grain, one-eighth of a grain, one-tenth of a grain, and one-tenth of a grain.

Arsenic in
all-malt beer.

4146. So that they were nearly as arsenicated as the ones which were brewed with glucose?—Some of them, undoubtedly.

Breweries
implicated in
Lancashire.

4147. Were the brewers who brewed with the sugars which you have samples of Manchester and Salford brewers, or were they brewers in other parts of the county?—They were distributed all over the county. Some were well-known Manchester and Salford brewers, but there were brewers distributed all over the county.

4148. I see that in the map which you have given us showing the numbers attached, the cases are most numerous round Warrington, Darwen, and Huyton-with-Roby?—Yes, but there are also a good many at Heywood.

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(*Professor Thorpe.*) There are so many that the dots cover the area.

4149. (*Chairman.*) Yes, I see you have a cross there?—That is a death.

4150. I was going to ask whether you thought that these cases in the places I have mentioned were in connection with local breweries?—Yes, in the case of Heywood it was a local brewery; we prosecuted a retailer who sold beer from a local brewery, and they used Bostock's sugar. In the case of Gorton it is quite contiguous to Manchester, and the conditions that affect Manchester would also affect Gorton. The brewers of Manchester and Salford supply the beer to Gorton.

4151. (*Dr. Whitelegge.*) You prosecuted the brewer, did you?—The brewer, indirectly. We prosecuted the retailer, but of course the brewer has always borne the brunt of the prosecution. It was a tied house, too.

4152. (*Chairman.*) Accrington; that would be a local brewery, too, would it not?—I cannot speak to that. I may say that Accrington is not policed by the county, and therefore I cannot speak with any confidence. It is one of the exceptions.

4153. And Ashton-in-Makerfield?—Ashton-in-Makerfield was influenced by the brewer who manufactured beer in the vicinity of Warrington, who has been spoken of several times.

4154. That would be one centre almost?—That is exactly the case. Earlestown and Warrington and all about there were the cases of one brewer, and all the cases that I came across were exceedingly acute cases. I have the beer of that brewer at the present time, and I must say that the brewer has given me every assistance in trying to get rid of the material, and in every case compensating and doing all that he possibly can. The glucose was given to him in lieu of American glucose. He was in absolute ignorance. That is an interesting case. One knows exactly when he used it, and exactly when the cases started, and as they were all characteristic cases of course it becomes of very considerable medical interest. Many of the cases are now under observation.

4155. He used American glucose?—No; he had Bostock's glucose given to him in lieu of the American glucose, which he had been using, and which he contracted to use. The American glucose had run out, and they said, "We are sending you some English glucose. This is really better," and so on; "You do not mind taking it?" He said, "No, I do not mind taking it; if it will do for me it is all right." But it was all wrong. I now place before you the key to the distinctive numbers of the breweries that I give on this table 1, so that there you have full particulars. (*Document handed to the Chairman.*)

4156-7. This is valuable to us, because it is showing that the incriminated beer was made over a wider area than we have yet got evidence from?—Yes, a very wide area. I may say that in one or two breweries where the arsenicated beer was very marked, the brewers withdrew their beers, and the public have never heard anything of them. They were fortunate in getting rid of their beer, and for some reason or other in the districts where they sold their beer, cases have either not occurred, or not been recognised.

4158. (*Professor Thorpe.*) What do you mean by saying they were fortunate in getting rid of their beer?—I think it is very fortunate to be able to escape the poisoning of the public. They took the matter in hand very early, and they rested neither night nor day until they had recovered every barrel of beer; and I may say that that specially refers to the gentleman whose beer I have spoken of as being so very bad.

4159. (*Chairman.*) You are referring chiefly to the 5,313 barrels which you have noted in this further table of arsenicated beer.

to you as having been destroyed under police supervision between December 10 and February 23 by 33 brewers (including some Manchester and Salford brewers) who supplied beer in Lancashire?—In my remarks just now I was referring specially to the Warrington brewery, because there this beer was bad, and I may say that the brewer himself was poisoned, and he spared no pains to get the beer removed, and it was removed. Until he could sell proper beer I do not think he sent any out of the brewery. That, of course, applies

Destruct
of arseni
beer.

Mr. Sergeant. to other brewers at the same time. They acted very well in the matter. The total barrelage of beer given represents the material destroyed. You will see that that spreads over the whole county, and you will notice that in many districts mentioned, where large quantities of beer were got rid of there were no cases. You will observe this in the north of the county—for example, at Ulverston.

4160. The point you wish to draw attention to now, particularly, is that over a large portion of your district, in the north of the county, no cases or few cases of poisoning occurred, or were recognised owing to the very praiseworthy and rapid action of the brewers in withdrawing the beer, as soon as they knew it was contaminated?—I think so, and I also suggest that in some districts more attention, probably, has been paid to the recognising of cases of poisoning than in others. That has something to do with it.

4161. You have informed us that this destruction of beer was, in a sense, voluntary on the part of the brewers. You have no power to compel them?—A very large destruction of beer took place owing to the action of the brewers themselves. The beer I spoke of was destroyed at our suggestion. When it was certified that beer contained arsenic by a preliminary test—Reinsch's test—the police informed the retailers. On my instructions they told the retailers that they must seal up the remainder of the barrels of the brew that had been found to be wrong, and they sealed them up accordingly. Whether the police had the right or not to act as they did does not matter. They simply said, "These barrels must be sealed up. The people must not be poisoned." And the retailers agreed to that. We did not trouble ourselves as to whether it was in accordance with the law or not.

4162. As to whether you had legal power or not?—We did not consider it. Our efforts continued until we could stop the sale of the poisonous beer. The procedure was not objected to, and, when the beer was found distinctly wrong, it was destroyed. No difficulty was experienced in destroying it. It was destroyed willingly. When it was found passable the seal was removed, and it was sold.

4163. (Professor Thorpe.) In other words, you laid an embargo upon the beer until you got further information?—Exactly, and if there had been any difficulty in getting rid of this beer, we should have had to consider whether we could not seize it, under sections of the Public Health Act, or the Public Health Acts Amendment Act, as food unfit for human consumption. We should have had to consider that, I suppose, in case of obstruction, but we had not that difficulty to encounter.

4164. (Chairman.) You say, "In my opinion it would be unsafe to allow the consumption of beer containing an amount of arsenic capable of estimation by the analyst." Would you explain a little further what you mean? Do you mean by that an estimation of the arsenic in a given quantity of beer, or that he may use as much beer as he likes?—Of course we know it would be capable of estimation, taking a very large quantity, but I am speaking now of the ordinary samples that we send. We have six quarts of beer divided into three parts, each part being two quarts of beer. I presume if you take a huge quantity of sea water, you might detect a certain amount of gold in it, and the same with beer. Any beer, I think, would scarcely escape having a minute quantity of arsenic; but if, in the ordinary practical sample that is sent to an analyst, he finds arsenic as a trace, and, as Dr. Campbell Brown said, not capable of estimation, I do not think that we need interfere in the matter.

4165. That is to say in a quart of beer?—No, two quarts of beer.

4166. But practically if he had two quarts to deal with he would probably only use one for examination at a time?—Well, I know that there is a very delicate method of ascertaining the arsenic.

4167. I am not pressing you about that?—I should think you are right in saying that a quart would be taken.

4168. If the presence of arsenic was not detectable in a quart, you would be satisfied with regard to the safety of the public?—I am afraid I had not in my mind the amount of beer that should be taken. I think amongst chemists it is usual in examining water, or other articles, to say that a certain mineral, or whatever it may be, is present as a trace. Well, if it is a trace, I presume that that is not capable of estimation, unless you make a special estimation of a large quantity. Of course, if

you do get a large quantity, no doubt you would be able to assess it, but it is very minute. It would be a trace, and even if you assess it, it would be a very minute fraction.

4169. The object of my question is rather to gain from you information, if I can, as to the quantity of beer that you thought ought to be used by the analyst for this examination?—I am afraid I would not like to specify that. I would not like to specify the amount that should be found. I do not think the beer should contain arsenic at all really, beyond the merest trace. In the samples we have obtained for analysis we found 75 per cent. to be genuine, and if 75 per cent. are genuine I do not see why we should not have 100 per cent. genuine.

4170. They are only genuine upon the sample tried, which is a limited quantity of beer, and what I wanted rather to get your opinion upon was whether you thought that quantity was sufficient in safeguarding the public?—I think so, yes. It has been suggested by Dr. Campbell Brown that if you analyse the air of manufacturing towns sufficiently long in sufficient volumes you might detect particles of arsenic. There is no doubt about that. But then for practical purposes the air of a town is free from arsenic.

4171. It is your opinion then, as a medical officer of health, that the public health would be sufficiently safeguarded if no arsenic was detectable in a quart of beer?—I should think that that would be the case. I may say that in the prosecutions which have been instituted we have not taken action unless the amount of arsenic has been equal to one-tenth of a grain or more. Upon a less quantity than that we have not taken proceedings, because our desire was to remove all that we considered actually dangerous beers. After the one-tenth of a grain we come upon debatable ground as to the amount of arsenic. Probably we shall have to proceed further and take action where the amount is very considerably less than that, but at present, so far, our energies have been directed to removing actually dangerous stuff. We consider the beer at the present time is probably as good as it has been for years, if not better.

4172. (Professor Thorpe.) I venture to think that all you mean to imply is that any limitation must have reference to a definite quantity of beer, the absence or presence of arsenic in which is to be ascertained by some definite method?—By some definite method. That is by a standard method which should be adopted.

4173. Otherwise your statement is a mere relative statement—relative to the amount taken and the character of the test which should be applied?—Yes.

4174. (Dr. Whitelegge.) Who fixed that standard of one-tenth which formed the mark for the prosecution?—I rather suggested it myself. I thought we should have quite enough to do in getting rid of the beers containing one-tenth or more, and that beyond that the danger was not so acute.

4175. You do not say that beer containing one-fifteenth of a grain per gallon is not dangerous to public health?—I may say that whenever we found arsenic in quantities capable of estimation we had the beer destroyed, but I may say we did not take legal action. It was invariably destroyed where we found arsenic in the beer capable of estimation, even to one-fifteenth of a grain.

4176. You did consider it dangerous to health, but you did not direct a prosecution?—We considered it ought not to be drunk, at any rate, but we did not think it was desirable to haul them up in the Courts of Justice and punish them for a matter of that kind, because we know perfectly well that many of the questions affecting brewers were sprung upon them subsequently to finding saccharine and glucose impregnated with arsenic, for instance the question of malt and also the question of yeast.

4177. You distinguish between "beer slightly arsenicated but passable," and "beer containing an amount of arsenic injurious to health." Is that to be understood as based upon the one-tenth of a grain standard?—Yes.

4178. (Professor Thorpe.) The one-tenth of a grain is ascertained for you by a particular method used by Dr. Campbell Brown?—Yes. You see the beers were destroyed as far as possible when they contained an amount of arsenic capable of estimation.

4179. (Dr. Whitelegge.) Then one-tenth or more you would regard as more actively injurious to health?—Exactly.

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4180. Was it with your approval that the beer laid under embargo and found on analysis not to contain a high amount of arsenic was set free?—It was with my approval, and it was mainly on the suggestion of the public analyst, who occasionally on a certificate stated that the beer was passable and might be sold. I may say that these certificates have been sent to the superintendents first hand, and beers were allowed to be sold, without any reference to me very often. The County Analyst occasionally gave on his certificate as an observation: "This beer may be sold."

4181. What standard did you understand him to be following in certifying some kinds of beer to be passable—the one-tenth of a grain?—I do not know; he would not say that one-tenth of a grain would be passable; they would have to be less than that.

4182. Do you know how much?—No, I am afraid not. I should think that in many of the early cases he would not really assess the amount. He would consider that it was not capable of estimation. But he will be able to speak of that himself.

4183. So the term used by the County Analyst is to be taken in a different sense to that in the table above. I understood from you that we are to take the term "passable" as meaning containing not more than one-tenth of a grain?—I think I have already mentioned about one-fifteenth of a grain.

4184. We certainly should not consider one-fifteenth of a grain passable, or anything like it. The amount of arsenic found to be present in the samples of beer submitted to the County Analyst was certified as incapable of exact estimation in 52. Well, the 52 would be termed "passable" beers. Then in 45 it varied from one-fifteenth to $\frac{1}{2}$ of a grain. All those beers were destroyed. When it was one-tenth or more you prosecuted. That is the way I took it. Then to make it quite clear, in the table (Appendix 10, Table I.) are we to understand that "passable" means one-tenth or less?—No; I say "incapable of exact estimation 52." Then there were a certain number that were genuine, and in 45 the amount was found to be one-fifteenth to $\frac{1}{2}$. Where it was incapable of estimation—that is, the 52—it was allowed to be consumed, but where it was found in poisonous quantities—we will say one-fifteenth of a grain or even less than that—if it were capable of estimation, it was destroyed. But we did not prosecute unless we found one-tenth of a grain in the beer.

4185. Do you mind applying that to the table? "Genuine beer," I suppose, means beer containing no arsenic?—Yes.

4186. "Beer slightly arsenicated but passable," what does that mean?—That "slightly arsenicated but passable" would be beer containing arsenic in quantities not estimated.

4187. But none of them approach, as I understand you now, one-tenth of a grain per gallon?—Except in two instances none of them approach that.

4188. Then the third category, "containing an amount of arsenic injurious to health"?—That is containing one-tenth or more.

4189. I understand that the second list—those that are passable—do not approach the one-tenth?—Yes, that is so.

4190. So those you regard as injurious?—The "breweries supplying beer containing an amount of arsenic injurious to health" would number 31.

4191. You cannot give me the ratio of the number of grains per gallon on which the distinction between class 2 and class 3 is based?—Subsequent to December 3rd there were 24 prosecutions. The total number of samples containing a quantity of arsenic injurious to health was 45, but prosecutions only took place subsequent to a certain date. Previous to December 4th we had a number of cases that were seriously arsenicated where no legal action was taken.

4192. That I follow, but I rather wanted to obtain from you, if you could give it me, the point at which the line of demarcation was drawn?—What I say is that we prosecuted if the beer contained 1-10th of a grain or more of arsenic, and if it contained, we will say, 1-20th or 1-15th we certainly recommended the destruction of the beer, but did not institute legal proceedings. If it contained a minute quantity of arsenic I suppose that Dr. Campbell Brown would not go to the trouble of assessing the exact amount. He would say this, "From our preliminary analysis we consider that the amount is merely a trace, and we consider the beer

passable." That is really the position we took up on general lines.

4193. (Professor Thorpe.) But Dr. Campbell Brown surely was singular in that respect. I am not aware of any public analyst having taken upon himself to determine what should be the limit in amount of arsenic; in other words, to determine when it became injurious to health, and when it was not?—He will be able to explain his action I daresay. I am simply saying what was done and what the character was of the certificates received. I have got one here, and you will see there exactly what Dr. Campbell Brown stated. There you have his exact statement, and you will be able to see what he has said. (Document handed to Chairman.)

4194. (Chairman.) The quantities do not seem in all cases to be given. It states "serious quantity of arsenic"?—I may say the certificates at first contained "serious quantity of arsenic," and then we had to wait for subsequent analysis to designate the amount of arsenic present.

4195. (Professor Thorpe.) That was explained to us by Dr. Reid; that it was necessary to take prompt action to divide the beers; but I do not recognise that it was within his functions to determine this question?—I do not say anything about that, I simply had to act on what I received from the analyst, and we could not do any more. If the analyst reported or certified that a certain beer was passable, you quite understand that I could not take any other action than allow it to be passed. In fact, as I say, the superintendent first received the certificate, and he acted upon the certificate at once.

4196. (Dr. Whitelegge.) Did the certificate come to you or go to the superintendent of police?—The superintendent of police, the one who purchased the sample, got it.

4197. (Professor Thorpe.) Do you know that Dr. Campbell Brown was required to give a certificate in those terms?—If you would allow me, I would rather not explain as to the terms which were used by Dr. Campbell Brown. I have here the subsequent certificate that he used. You will see the form of certificate, and probably you will form an opinion yourself as to what terms should be used. That is the form. It happens to be one that I have got.

4198. (Dr. Whitelegge.) When the superintendent or inspector received this report, did he come to you for instructions?—No. When the certificate stated that the arsenic present was serious in quantity he communicated with the Clerk of the County, who discussed the matter with me, and we decided what action should be taken. In those cases where the amount was serious or stated to be injurious to health, we took, subsequent to December 4th, legal action, and in many of the early cases we had to wait for the complete analysis showing the amount of arsenic actually present.

4199. This is not a final certificate, I presume, is it?—Yes. This is a final certificate.

4200. Upon which proceedings would be taken?—We took proceedings on that.

4201. (Professor Thorpe.) Was no other certificate presented eventually?—That is the certificate on which we took action.

4202. (Dr. Whitelegge.) Without the quantity being stated?—The quantity was stated subsequently. On application on the part of the defendant in the case we gave further information. That, I must say, has given rise to some difficulties in our prosecutions, but seeing that the county analyst received hundreds of samples, you can quite understand that there would be a difficulty in giving at once the amount of arsenic present in each case. Of course, our chief action was taken on the preliminary examination, when a wire was sent to us stating that it contained either a slight amount of arsenic or that it contained a large quantity of arsenic. On receipt of wire we acted, and promptly, too. That was the chief action, and very important in the early cases, that is, from November 27th to December 4th.

4203-4. What do you mean by "took action"? Did and do you lay an embargo on the beer?—As soon as we got a tion of wire from the County Analyst that a serious quantity of arsenic was present, or that arsenic was present in quantity at all, we telephoned to the superintendent of police, and told him sample number so-and-so contained arsenic, and that he must proceed to the retailer, and see that the barrels affected were sealed up. That was

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done at once, pending the action necessitated by the complete analysis.

4205. Legal proceedings, you mean, would probably ensue in that case?—Legal proceedings ensued in the cases where the result showed that a serious quantity of arsenic was present.

4206. This is signed by both analysts?—There are two appointed analysts.

4207. Acting together?—Yes.

4208. Not for different parts of the county?—No, they act together. They are both county analysts.

4209. Have you any staff of your own for the purposes of the administration of the Sale of Food and Drugs Act?—No, I have no staff under my own express direction, but I have had the assistance of the police, and it is very valuable, because I have been able to cover the whole county; without the police I probably should have wanted a very large army of inspectors. There is one inspector, who is appointed by the Standing Joint Committee, who devotes his attention chiefly, I think, to the purchase of samples of milk, and butter, and cheese—chiefly agricultural produce.

4210. Does he act under your direction in any way?—He does not. But indirectly; if I want anything doing I can always send the police, as in this matter. The chief constable kindly allows the direction of affairs in matters relating to the Sale of Food and Drugs Act to be entirely in my hands.

4211. Then you have on former occasions taken part in the administration of the Sale of Food and Drugs Act?—Undoubtedly; in fact, one of my duties is to advise and supervise the action taken under the Sale of Food and Drugs Act.

4212. Were inquests held in the cases which ended fatally?—I think I have information of two inquests.

4213. Do you say there were not inquests in the other cases?—One inquest was held, as I have previously mentioned, at my instigation in the neighbourhood of Warrington, and in the other case an inquest was held at Gorton.

4214. And the coroners in the other districts did not consider it necessary to hold inquests?—I cannot give the reason; I am not aware at present that inquests were held.*

4215. You mentioned a fatal case as having taken place at Wigan on August 16th?—Yes.

4216. Was that at the time known to be an arsenical poisoning case?—I do not think it was known at the time, but the doctor who had it removed was very much startled, as doctors were in other places, by the curious symptoms that affected a number of his patients. This patient was removed, and she died of arsenical poisoning. She had all the symptoms of arsenical poisoning, and her habits were of such a character as would probably induce one to assume that she was affected by the drinking of beer. She died from peripheral neuritis, but the doctor now has no hesitation in saying that she died from arsenical poisoning. That is in the light of subsequent events.

4217. (Chairman.) When did Dr. Hitchon communicate with you?—I have got here the report. This is the report I received from him on the subject. (Handing in report to Chairman.) It was subsequent really to the information I got from other districts.

4218. I see this is the 29th November?—It was in consequence of a letter that I wrote to the medical officers of health he sent me that report. It is a copy of a report he presented to his committee.

4219. I mean the earliest cases that have been made known to you are those referred to in a special report by Dr. Hitchon, the medical officer of health for Heywood. He did not communicate with you?—Not at that time.

4220. Not until after the connection between the epidemic and arsenic was known?—That is so. I had no information in the early inception of this.

4221. So that, although there were in his district an unusual number of persons suffering from affections of the skin, and feet and hands—"the feet and hands were red, swollen and painful"—that had not aroused suspicion of anything in the shape of poison?—Not at

that time. I think two or three, including Dr. Hitchon, and I may say, Dr. Latham, of Ashton-in-Makerfield, and Dr. Mouncey, of Earlestown, were considering the matter, and coming to a conclusion, when the matter was brought prominently forward in Manchester about the 23rd November.

4222. So that he, as a Medical Officer of Health for the district, did not refer to you until the connection between arsenic and beer had come forward in Manchester?—Yes, that is so. This is the letter I wrote to many medical officers on the 28th November (producing letter).

4223. Thank you, but I wish to get, if I can, more information as to the commencement of anything being suspected. You have not had your attention drawn, since you have been Medical Officer of Health, to an increase in the number of deaths from what I may term nervous diseases?—Not previous to this matter.

4224. Not in previous years. They have not been gradually increasing?—I have not noticed it. I got this information that I tabulate as to the number of deaths, as a result of special communications sent to local medical officers of health. You have it in detail.

4225. That only alludes to two years. I was asking if you could give me any information for, say, five years back?—I have not got that information. I could get it, but it has not been obtained. It was in the early inception of the affair, and I thought this information would be of value. I only asked for this information, in the MSS., and I have already given a summary (Appendix 10, Table II.).

4226. You say "From my own investigation I felt justified in saying that many deaths from arsenical poisoning during the last half of 1900 have been registered as due to alcoholism, locomotor ataxy, Addison's disease, and spinal sclerosis," and so on. Have you any idea of the number of cases of Addison's disease which have been registered in that time, because it is a rare disease?—It would necessitate a prolonged investigation in various districts, but I can mention several cases, sufficient to cause me to believe what I say here. In Gorton, for instance, there are two or three cases of Addison's disease, distinctly reported. Then, as I told you, there was a case of locomotor ataxy that came under my notice, and also spinal sclerosis, and diseases of the liver. All those cases have been given as the cause of death; and local medical officers have told me that they considered such cases ought to be returned as caused by arsenical poisoning, because of their own knowledge they have been aware that such persons have been large consumers of beer, and so on. In fact, I have been requested to put in the list of deaths as directly due to arsenical poisoning cases which were not returned to the Registrar as such.

4227. My point is this rather. Have the number of cases of death from Addison's disease, not during the last year, but during the last five years, been higher than the average during the preceding five?—I cannot speak of that. I have not the information. My information is really from general examination, and I could not carry out a complete system of localised investigations because being such a big county it is impossible for one individual to administer this, and also make careful medical examinations. If I could have had two or three medical assistants I should have been able to do it, but as I am alone it would be really impossible for me to do it.

4228. I thought you might have the death mortality returns sent you?—I do not get the detailed deaths from various causes. In fact, I have not been accustomed to receive the deaths from alcoholism and the other causes which are mentioned here.

4229. Some of these cases would hardly be likely to be confounded with arsenical poisoning, would they; for instance, spinal sclerosis?—I can give you the name of the doctor who asserted to me that he had one case that had been given as due to this cause, spinal sclerosis, and in his opinion it ought to have been poisoning from arsenic. He gave it to me as one death which ought to have been included in the list that I have given you here—the list of deaths distinctly due to arsenical poisoning.

4230. Locomotor ataxy?—I can speak of that from definite knowledge, because in the case where I suggested a post-mortem should take place, the cause of death was returned as locomotor ataxy. I attended the post-mortem, and as I tell you, the liver, the spleen and the

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Arsenic poisoning attributed to Addison's disease, locomotor ataxy, and spinal sclerosis.

* Note by Witness.—Returns subsequently received from medical officers of health showed that five additional inquests had been held.

Mr. E. Sergeant. kidneys were found to contain considerable quantities of arsenic.

26 Mar. 1901. 4231. I suppose a man with locomotor ataxy might be a big beer-drinker?—There were distinctly symptoms of arsenical poisoning—most characteristic symptoms. He drank the beer that others did in the same neighbourhood, next door, and in adjoining houses, and they were suffering from arsenical poisoning. He drank this beer, and during the time he was ill he also drank the beer, and he died from drinking the beer; and when he was dead we found arsenic in the various organs that I have spoken of. That was returned as locomotor ataxy.

4232. (Dr. Whitelegge.) Is that one of your 12 cases?—That is one of the fatal cases where inquests took place.

4233. (Chairman.) I am not in the least questioning what you wish to say, but surely the symptoms which have been described to us over and over again are very far distant from the ordinary symptoms of locomotor ataxy?—I think that the death, if I remember, took place somewhat early in the affair, and things had not proceeded sufficiently for the medical man to diagnose it as due to arsenical poisoning. He died on the 30th November, and that was rather early in the affair. I cannot explain, and I am not going to suggest anything as to what influenced the medical attendant in his diagnosis. There are various reasons for medical men not giving the true cause of death in their certificates. I do not say that it is so in the case mentioned, but I fancy in certificates the desire not to hurt the feelings of members of the family has perhaps induced certain medical men to give a cause of death which may not be so unpleasant to the relatives as arsenical poisoning. I believe that has influenced medical men. There are many men who rather jib at the idea of giving the cause of death as, we will say, alcoholism.

4234. I perfectly follow it. I perfectly understand that a number of deaths due to arsenical poisoning might have been recorded as due to other causes, but I also wish to guard against thinking that it is not impossible nervous symptoms perfectly unassociated with arsenic are now put down to arsenic. Those are the two things that were passing in my mind?—I can speak definitely of one case, and that is one of locomotor ataxy. I think that is proved by the subsequent finding of arsenic in the various organs. That is one definite case that I can speak of; with regard to the other cases I can give you the name of the medical men who largely influenced me in the statement that I made there, if you care to have his name.

4235. (Dr. Whitelegge.) You told us of 12 deaths* and said inquests were held in two cases. In the other ten, are we to understand that arsenic was mentioned in the certificate, or are they merely cases which, having regard to all the circumstances, you now put down to arsenic?—I sent out a form to various medical officers of health in the county, and asked them to give me information as to the deaths from certain causes, the cases from arsenical poisoning, and the deaths. This is the list of the cases which were returned, and they give me those deaths without any special information in many cases.

4236. Did you obtain returns from all the medical officers of health?—I sent to all of them.

4237. And you got returns from them?—I got returns from a certain number. I think the number is 124. Unfortunately the others did not send me the returns, the assumption being that there were no cases in those districts. But in order to get the returns from the districts it necessitated writing many times, and sending telegrams, and in the case of the balance I could not get the returns.

4238. And you were obliged to make up the returns from those you got?—I was obliged to make up the returns from 124 districts.

4239. Do you know by what means the medical officers of health in the districts from which you have returns obtained information?—I cannot speak specifically on that point. In fact we have had so much difficulty in getting returns. I thought I might possibly ask for more information than many of them

Mr. E. Sergeant. would give, and rather stopped asking for it. In fact, in one case the medical officer asked me who was going to pay him for getting this information, so I thought I was getting very near to the end of my tether on that matter. 26 Mar. 1901.

4240. (Professor Thorpe.) Dr. Whitelegge pressed you to form one, of what was connoted with the terms used by the public analysts in their certificate—the terms such as “serious,” “much,” “little,” “passable.” Those were terms which were employed in the certificates in the first instance?—Yes.

4241. And you subsequently got further information of a quantitative nature following on those certificates?—Yes.

4242. When you took an action into court, upon what certificate did you proceed?—That represents the sort of certificate that I proceeded upon.

4243. The certificate that you got in the first instance?—No, not in the first instance. The first was a wire, which stated, “Arsenic is in No. so and so,” giving the number of the samples, or of the one sample, as the case might be. In that case we communicated with the superintendent who purchased the samples.

4244. I have been trying to get from the returns which you have been so good as to present here, what quantitative idea would be attached to these terms. If I have followed you correctly, it seems that your action has been wholly based upon a qualitative indication in the first instance. I am speaking of the embargo you laid?—Yes, the qualitative; that is so.

4245. It was entirely directed to a qualitative indication?—Yes. In fact, in the early cases I do not think a quantitative analysis was made really.

4246. I notice with regard to a certain sample which was purchased on the 4th of December that the analyst reported that it contained “much arsenic”?—Yes.

4247. The number of the sample is 873. You proceeded upon that, and the man was fined £5 and costs?—Yes.

4248. On December 4th, the same day in fact, there was another report sent to you in which it was said that the beer contained a small quantity of arsenic. That turned out to be as much as one-sixth of a grain?—What number is that that you refer to?

4249. That is No. 651?—That contained a quantity of arsenic—one-sixth of a grain.

4250. Is that the quantitative idea that you think we ought to associate with these terms? Here you have “much arsenic,” where you have one-seventh of a grain, and here it is reported as “a small quantity,” and it is afterwards reported as one-sixth of a grain?—You see the information that I received. I did my best to work on the information that I had. I was not responsible for the information that was sent to me. You have here the first results of the examination; and then the second results giving the exact amount. We did our best. Of course there may have been correspondence or wires and so on in these cases where there was a little doubt as to what was meant by “much,” or “a small quantity,” or “contained arsenic,” without any qualifying word. We had in some cases to wire or to write. I cannot in individual cases give you the information. No doubt I had to further communicate with the county analyst on many of these samples, but I myself do not wish to explain why in one case the analyst should say simply that it contained arsenic, and in another that it contains much arsenic, and in another a serious quantity of arsenic. I do not propose to explain that. It is possible that Dr. Campbell Brown may appear before you and be able to explain perhaps the reasons for that.

4251. Yes, but it would appear from the table that you prepared for us that these terms, “much,” “serious,” “little,” and “small,” really do not connote any quantitative amounts?—We went on the broad principle that if it contained arsenic action should be taken, and in the cases I have mentioned before, where it was serious, that was sufficient to take action, without any further reference to him. In many cases we had to communicate with the analyst for further information. The tables have been prepared from information contained in final certificates.

4252. (Chairman.) In fact your object was to secure rapidity of action, and not wait until you had definitely finished your analysis?—That is so.

4253. Therefore, I should be right in imagining that this particular sample, 651, which was first reported as

Statistics obtained by Lancashire County Council incomplete as regards several districts in the County.

* Note by Witness.—Returns subsequently received from Medical Officers of Health showed that three additional deaths (making 15) had been attributed to arsenical poisoning.

Mr. Sergeant. "a small quantity of arsenic," has been subsequently examined, and turned out to be a very much more contaminated sample?—That is so.

4254. (Professor Thorpe.) But the point I wish to put is that the course of justice was somewhat prejudiced by the use of these terms in a somewhat vague sense?—You see a case was not heard until we had a definite amount to give.

4255. (Chairman.) The action taken upon these vague statements (if I may use that phrase), was that of impounding the beer, and the action of prosecuting was not taken until after the quantities had been estimated?—I could not say that that was the case in all cases, but as a rule we waited for the exact amount. Of course, under the Sale of Food and Drugs Act, the action must be taken under a certain number of days—28 days, I think.

4256. (Professor Thorpe.) What it means is that before the case was ripe for hearing, you had got the quantitative information?—Exactly; that is so. Of course, if we discovered, we will say, that there was less contamination than we at first contemplated, the case would be withdrawn. In one or two cases we did withdraw.

4257. (Chairman.) In such a case as this, for instance, between the serving of this notice and the action coming on, probably a second examination for the purpose of discerning the quantity had been made?—Undoubtedly.

4258. And if you had found it was a very small quantity, you would have withdrawn the action?—Yes, if it had been very small; if it had been less than one-tenth of a grain we should have withdrawn.

4259. But if you found it amounted to anything like one-fifteenth or one-tenth of a grain, you would have gone on with your action?—Not one-fifteenth.

4260. But one-tenth?—Yes. In this case, No. 227, where certain action was taken, it says, "Contains a serious quantity of arsenic." That is the first notice we have about it. Then the subsequent analysis shows the presence of two-thirds of a grain per gallon.

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4261. (Chairman.) What are the reasons of the medical men, with whom you have been in communication, which lead you to think that much sickness could arise from the consumption of immature beers brewed one week, and sold the next?—The assumption of some medical men that I know, and who have been heard in this matter before, is this; that these glucose beers are sold before what is called the cask fermentation takes place, and their opinion is that when these beers are drunk the fermentation may take place in the stomach, and account for some of the vomiting that takes place amongst consumers, as is well known amongst retailers of beer—sudden vomiting and very often gastric symptoms that cause them to seek the advice of a medical man about. That is the impression. They consider that years ago when beers were properly matured and sold after what is called secondary or cask fermentation, the same amount of violent sickness was not induced as in the case of immature beers. I observe myself these men have a considerable amount of sickness, and I rely upon old practitioners, who seem to be very strong about it. In the course of my investigations they urged me to bring this matter forward.

4262. The fact that vomiting is quickly excited would be rather favourable to their escape from subsequent trouble?—No. I do not think it would, because they return after their vomiting to further beer. I have seen that myself, and it may be seen near many of these public-houses on a Sunday. You will find a good many beer drinkers waiting for the public-house to open, and occasionally you will find one man suddenly emitting large quantities of beer upon the pavement, and another man will follow suit. As soon as the public-house opens they troop into it and drink further large quantities of beer, and risk what the further effect may be upon their stomachs. That is what I have noticed. They do not really give it up. In fact, many of the beer drinkers who were poisoned with arsenic, although they have not recovered, have returned to their beer-drinking. They think the conditions now are safe, and they can do it with greater satisfaction to themselves, and with less danger to health, too. Holding such views, I have not a good opinion of many of these people who drink

beer. May I mention one thing? That is with regard to the passage where I say, that difficulties have arisen owing to the difference of views with respect to the character of beer. A brewer has just said that if samples of a certain beer were distributed to half-a-dozen analysts you would have probably half-a-dozen opinions respecting it. I do not know whether it is so great as that, but at any rate the difference has been considerable. We prosecuted in two or three cases where a certificate had been openly exhibited in the retailer's house, that the beer was brewed from malt and hops, and that it had been examined by certain well-known analysts, and found to be free from arsenic. Two or three prosecutions have taken place under those circumstances. On another occasion we found attached to the barrel this document here (*producing document*), which privately you may look at, where it is stated that the brew has been examined and found to be free from arsenic. We had to prosecute, and there was no objection taken to the result of the analysis by the county analysts. In another case the difference among analysts was very marked. A brewer came to me with respect to his beer that had been found by the county analyst to contain one-tenth of a grain of arsenic. He stated to me distinctly, and I believed him, that the beer was made from malt and hops only, and that being the case I myself had very great hesitation in suggesting that a prosecution should take place. A further examination was made by the county analyst, and he stated that undoubtedly it contained one-tenth of a grain of arsenic per gallon. When the case came before the magistrates it was arranged that the remaining sample should be sent to Somerset House. The sample was sent to Somerset House, and in due course the beer was certified containing one-hundredth of a grain. We had also obtained from the brewer a certificate from an analyst of repute showing that it contained one-eighth of a grain, and another where it said that it contained one-hundredth of a grain. Yesterday I got a certificate from a well-known chemist, Dr. Stevenson, who said the sample showed one-sixth of a grain. So you have men of the highest eminence differing. I have certificates from three analysts, and then there is Dr. Campbell Brown four, and Somerset House five, and these good people all differ. That I think shows the desirability of having a uniform system or mode of procedure which is defined and specified, so that an analyst can carry it out with a better chance of agreeing with his confrères.

4263. I think it is quite possible that these differences may arise from the bottles into which these samples are placed. I find here that Dr. Stevenson has only had sent to him about one-fifth of a pint, and that probably may have been put into a bottle very imperfectly cleaned. It is quite clear that it is exceedingly undesirable that there should be these discrepancies, but it seems to me that discrepancies such as those you have mentioned depend upon the way the samples are taken, probably, rather than upon the analysis the chemist makes?—I do not think that would be the explanation, because Dr. Campbell Brown sent to Dr. Stevenson the sample, and I think, presumably, he would send it in a clean bottle not containing arsenic.

4264. (Professor Thorpe.) But could you attach the same amount of importance to determinations that were made upon one-fifth of a pint, as you would to one that was made upon a quart?—I am only giving the result. If Dr. Stevenson thinks himself justified in saying that this contains one-sixth I do not wish to say whether it is sufficient or insufficient. He, as you know, is an expert in poisons, and very often in criminal cases of great importance he has to give evidence, and on his opinion results very often of life or death depend. And therefore I simply take what he says, that he finds a certain amount, and he does not say the amount that was sent to him was insufficient to allow of a proper analysis. We have had another case of a similar character. In fact, we have had many lower part of cases, and it has been suggested that the upper part of a barrel the barrel is more free from arsenic than the lower part of the barrel. That is another suggestion that is very unpleasant, because the lower part of the barrel might be very poisonous, and necessitate a person who is going to indulge in a pint of beer asking whether it was from the upper part of the barrel or the lower part of the barrel before he drank it.

Mr. E. Sergeant.
26 Mar. 1901.

Conflicting results obtained by different analysts with arsenical beer.

"In certain portions of the barrel of some of the samples sent to the analysts, it was found to contain arsenic."

May be more arsenic in the lower part of a barrel.

Mr. FRANK SCUDDER called and examined.

Mr.
F. Scudder.
26 Mar. 1901.

4265. (Chairman.) You are, I think, a consulting chemist practising in Manchester, and chief assistant to Sir Henry Roscoe?—Yes.

4266. You have had considerable experience of testing for arsenic before this recent epidemic?—Yes, especially when I was associated with the late Dr. Angus Smith in his work as inspector under the Alkali Acts, testing for arsenic in coal smoke, flue gases, and in gases given off in glass houses, and in the air and coal smoke of Castleford. Also in poisoning cases, and in the examination of wall papers for arsenic.

4267. Since the epidemic have you analysed beers and beer materials for your own interest, and also tested samples for brewers?—Yes, and also for the consumers of beer—private individuals.

"Minimetric" method of estimating arsenic in beer by comparison of Marsh mirrors.

4268. These experiments, together with your former experiences, have led you to form conclusions as to the methods of estimating arsenic in small quantities in beer and beer materials?—Yes, I soon found out that it was a most difficult problem to get reliable and trustworthy quantitative results. It was comparatively easy to find the presence of arsenic in the beers qualitatively, but the accurate determination of the quantity present required a great deal of investigation owing to the arsenic being present in such a large volume of an organic liquid containing so much solid matter. I was anxious to find out if the Marsh test could not be applied as a quantitative one to the examination of beer. Knowing the extreme delicacy of the test I determined to adopt a method of analysis taught me years ago by Dr. Angus Smith, and which he called *minimetric*—the object being to ascertain the smallest quantity of beer required to produce a mirror of arsenic of a given density.

4269. Would you explain what you found—the quantities of beer with which you worked, and the results so far as the mirrors go?—I will come to that a little later on. I will go on to a description of the apparatus.

4270. Perhaps you will tell us the method you adopt?—Yes. I propose to refer to it as the Marsh test, inasmuch as the chemical reactions involved in the test used by me are the same in principle—that is to say the test depends upon the production of arseniuretted hydrogen gas and the subsequent deposition of the arsenic in the elementary form as a mirror. The form of the apparatus which I have adopted for the examination of beer is exhibited. This is a drawing identical with the size of the apparatus I used (*producing drawing*.) It is necessary to produce hydrogen gas from an outside generator. I use a kip generator which is not shown on the drawing, the hydrogen gas produced is first passed through a tower filled with glass beads moistened with mercuric chloride solution, and then through two towers filled with beads moistened with a solution of silver nitrate in order to get the hydrogen at this point free from impurity (*explaining on the drawing*). Here you have the reducer (*producing model*). You can have three of these connected to the hydrogen supply and worked together side by side, or you may pass the hydrogen through any one of them.

4271. Or all of them, if you have enough?—Yes. The reducer consists of a preparation tube 6 inches long by 1½ inches diameter, fitted with a white india rubber stopper having three holes, one for inserting a stoppered funnel for introducing liquid, a second for exit tube for hydrogen and arseniuretted hydrogen fitted with an upright tube containing a roll of filter paper 3 inches long by half inch diameter. On the tube is bent at right angles a chloride of calcium tube, and at the end of this a piece of combustion tubing drawn out sharply to a fine bore not greater than 2 m.m. outside diameter at a distance of 1 inch from the wide part of the tube. In the third hole is fitted a glass tube for introducing the hydrogen from the outside generator. There are many details of construction about this apparatus which it is essential to follow. In the first place, if you want to make standard mirrors it is essential that you should have your tubes of even bore. Many analysts have failed to detect small quantities, inasmuch as they have attempted to deposit small quantities of arsenic over a large area, in a tube even as large as that (*indicating*).

4272. (Professor Thorpe.) You mean as wide as that in bore?—Yes, as wide as that in bore. The consequence is, when you have got very small quantities of arsenic

you do not see it; it is lost to sight being spread over too large a surface. Therefore, when you limit yourself to a tube of this diameter you are able to obtain mirrors which would otherwise escape detection. Then, again, one great advantage of having hydrogen from an outside source is this, that you can sweep your apparatus free from oxygen, and after you have swept it away you can allow the reduction to take place in the tube. Then instead of relying, as many analysts have done, upon strengthening the liquid with fresh acid to throw off the arseniuretted hydrogen from the apparatus you have simply to turn on hydrogen from an outside source and sweep it through at a constant flow. Anyone who has attempted to make standard mirrors will know it is a very difficult thing to do—in fact, it is almost impossible—to make standard mirrors without the use of an outside generator. The object I had in view in making my apparatus was to make them definite and make them of a given density, and confined within a limited length of the depositing tube. I can show you a set of mirrors prepared in that way, the object being, of course, to make as clear a line across as possible, quite distinct—not to have the mirrors long. A lengthy mirror is no use to you for comparison. That is the form of metal I used for the reduction (*exhibiting specimen*). It is magnesium. I think that is sufficiently descriptive of the apparatus. But I wish to make the point clear that it is essential these sizes should be followed, that it is essential you should not attempt to carry out the test in a tube of that width (*indicating*). The method of testing is carried out as follows:—The beer to be examined is first boiled to expel the alcohol, cooled, and made up to its original volume. In the reducer is placed a piece of magnesium rod (cleaned by dipping in nitric acid and well washed), 1½ in. long × ⅛ in. of an inch in diameter, and the apparatus swept clear of air from the outside generator. Of course we have to remember what is the chemistry that goes on within the reducer, and what work is required to be done. It is not the weight of material put in; it is the surface area of metal exposed to the action of acid that brings about the rapid and complete evolution of the arseniuretted hydrogen. If you were to put a piece of magnesium the size of a pea in the reducer, you would get a different set of mirrors. You must ascertain the area required to drive off a given quantity of arseniuretted hydrogen in a definite time. The reduction tube for the mirror is then heated under the full flame of a Bunsen burner, and the hydrogen flame at the jet regulated to 1 millimetre in height. The jet burns at this end of the tube, and it must not exceed 1 millimetre in height. You can conduct an arsenical determination, and you will find no arsenic deposited in the tube, simply because you have perhaps got 3 millimetres or 4 millimetres' height of flame.

4273. The gas is passing away rapidly under too great pressure?—The gas is passing too rapidly. You must allow it to flow slowly; the slower you go the better mirrors you obtain.

4274. (Professor Thorpe.) Under those circumstances do you find that the flame 10 millimetres high is arsenic free?—That is arsenic free.

4275. Does a little flame at the end give you no garlic smell?—None whatever.

4276. Have you let the flame impinge upon anything, say nitrate of silver or corrosive sublimate?—I have tried experiments that way. That was one of the points I had to prove—whether the Bunsen burner was sufficient to deposit the whole of the arsenic, so instead of having the tube bent down like that (*indicating*) I carried it forward. I passed it through silver nitrate, and it did not indicate the slightest trace of the escape of arseniuretted hydrogen. You can do it, of course, if you do it too fast; it is all a question of speed.

4277. You have assured yourself that as you do the test no arsenic escapes?—Yes, that is a condition you must fulfil to make the process reliable. I have a series of three reducers, because I work upon one cubic centimetre of beer, 5 cubic centimetres of beer, and 25 cubic centimetres, all at the same time. Into each of the three reducers is run one centimetre, 5 centimetres, and 25 centimetres of the prepared beer respectively. Then 5 centimetres sulphuric acid (containing 50 per cent. H₂SO₄) is introduced into each of the funnels of

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Mr. Scudder. the three reducers, and added cautiously and gradually over a period of at least half-an-hour into the reducer. If the amount of arsenic is very small, not exceeding 0.01 milligramme, it is advisable to turn off the hydrogen from the outside generator for the first half hour in order to allow the arseniuretted hydrogen to accumulate in the reducer. If this be done no flame is visible at the point of ignition. After half-an-hour the outside generator is turned on carefully, and for the next half-hour a flame not greater than 2 millimetres is maintained. On the other hand, if the amount of arsenic exceeds 0.01 milligrammes a flame of one millimetre is maintained for the first half hour, and increased to 2 millimetres for the second half hour. That is to throw the arsenic forward in the depositing tube.

4278. (Professor Thorpe.) Do you mean to distribute the mirror?—Yes. Otherwise you get grey mirrors which are of little use for comparison. The reason for this is that with traces of arsenic the mirror is so thin and spread out as to be almost invisible if the current of gas is maintained at one millimetre. On the other hand, if the amount of arsenic is large the current has to be maintained in order to get evenly deposited mirrors. I may add that I do not claim anything original for the thing except with regard to the conditions essential for accurate working. It is only a question of manipulative skill.

4279. (Chairman.) You make three determinations at the same time, so that you can compare from 5 cubic centimetres and 25?—And 1. I begin with 1.

4280. Are there any special points in the practical application of this method to which you wish to draw our attention other than those you have already mentioned?—No.

4281. You have been good enough to show us a series of standard mirrors?—I have made many various sets of standards from time to time during this investigation. I have two sets which I exhibit. The minimum standard is 0.001 of a milligramme of arsenious oxide, and the maximum standard is 0.01 of a milligramme. I have also prepared a table to assist in calculating the amount of arsenic present. When I take the 1 cubic centimetre, the 5 cubic centimetres, and the 25 cubic centimetres, by comparing it with the 10 mirrors, I can get at once the amount of arsenic, expressed in grains per gallon, from that table. For instance, if you find arsenic in 1 cubic centimetre of beer, it is clear that that beer contains an amount of arsenic not less than 1.14th of a grain per gallon. If you take 25 cubic centimetres of beer there you have a range from 1.36th part of a grain to 1.357th. I have a set of mirrors here to illustrate it. (Producing mirrors.) Those are beers using 1 cubic centimetre, and those are beers using 5 cubic centimetres, and those are beers using 25 cubic centimetres, 25 cubic centimetres being the largest amount necessary to take to carry out this test satisfactorily.

4282. (Professor Thorpe.) Have you determined whether all the arsenic is eliminated here?—Yes.

4283. Is all the arsenic transformed to arseniuretted hydrogen?—It is.

4284. You have directly proved that, have you?—Yes, it is.

4285. Of course, you know in the case of antimony the whole of the antimony is not?—That is so.

4286. A very considerable portion of it is left?—Yes, but that is not so with arsenic.

4287. You have definitely established that?—I have definitely established that.

4288. It has not been hitherto definitely established?—No, but I did that because I knew that would be one of the points raised against me—How do I know I get the whole of the arsenic out? I believe you can only do it by observing the conditions and working in the manner which I have prescribed.

4289. (Chairman.) Does the mirror differ at all in appearance according to the condition in which the arsenic is present—whether it be present as arsenious acid or as arseniate?—I paid special attention to that because if I was only estimating arsenious acid and not arsenic acid, it would not be enough; I must estimate both forms. I found that the appearance and density of the mirror would be the same, but the reduction would be slower, inasmuch as the nascent hydrogen has first to reduce the arsenic to the lower form, and this involves the use of double the energy required when only arsenious acid is present. In

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other words, it is only a question of time. This answer is based on experiments which I have made. If you start off with .01 of a milligramme of arsenious acid in the arsenic state, you eventually obtain the same mirror as from 0.01 milligramme of arsenious acid, but you have been expending your hydrogen, that otherwise would have been employed on the production of arseniuretted hydrogen, for reducing the arsenic acid to arsenious acid, but when once reduced it comes off. It is only a question of time. It is a beautiful experiment that can be used as a lecture experiment, showing the speed at which arsenious acid is reduced to arseniuretted hydrogen as compared with an equivalent amount of arsenic acid. It is just like precipitating copper electrolytically. Everybody would prefer to use the lowest oxide of the metal. Cuprous chloride will deposit twice as much copper as cupric salt in a given time. But I have satisfied myself that I estimate both arsenious acid and arsenic acid.

4290. Do you think there would be any difference in the mirrors if arsenic was introduced in combination with organic matter—as cacodylate, for instance?—I have not yet completed the investigation with regard to the determination of arsenic in organic compounds of such a nature as cacodylic salts. I have, however, prepared mirrors from 0.01 of a milligramme of sodium cacodylate, 0.05 of a milligramme of sodium cacodylate, 0.01 of a milligramme of iron cacodylate, and 0.05 of a milligramme of iron cacodylate. These I exhibit. I have not quite finished the investigation of these organic compounds.

4291. (Dr. Whitelegge.) Do you get the same mirrors with a corresponding amount of arsenic?—Yes, those are the mirrors of the compounds.

4292. (Professor Thorpe.) Do the mirrors form quite easily as compared with arsenious acid?—Yes.

4293. In other words, the cacodylate is at once reduced and converted into arseniuretted hydrogen?—Yes.

4294. And with the same facility as if it were so much arsenious oxide?—Exactly. That is my experience. It is rather contradictory to all the evidence that I obtained from other chemists. I was always under the impression these bodies would be very difficult to reduce, and would not yield to the Marsh treatment. A friend gave me the compounds direct from Germany.

4295. Have you assured yourself of the absence of arsenious oxide from the cacodylates. Have you assured yourself that there is no arsenious oxide along with this cacodylate of soda, if it be cacodylate of soda, and this cacodylate of iron?—I have not completed the investigation. I have not made a proper analysis of those things.

4296. You are aware that most cacodylates do contain a quantity of arsenious acid?—No; I do not know that, in the quantities I have taken, it comes from the cacodylates. That is a matter for further investigation.

4297. (Chairman.) Have you reason for thinking that when you test beer, which in the course of brewing has become arsenical, you recover the arsenic to the same extent as if it was all present as arsenious acid?—With my present knowledge I am not prepared to answer that question. I think it is sufficient, in the position I take up, to say that I can detect 1.300th part of one grain per gallon in beer. Until the brewers can fulfil a test like that I do not think I can venture into this question.

4298. Have you examined any contaminated samples of beer which have been brewed with Bostock's glucose or invert?—I have examined highly contaminated samples of beer, but I was not informed by the brewers that they had been brewed with any of Bostock's materials. The highest amount of arsenious acid found was 0.7 of a grain, which was 4d. bitter beer, brewed on the 21st November, 1900, and analysed by me on December 5th.

4299. That is not a very large amount?—Well; that is rather a large amount; 0.7 of a grain is 7.10th of a grain.

4300. Yes, but I meant as compared with beers which contained a grain in a gallon?—I should think those are very exceptional.

4301. Have these beers been beers that have been brewed since the epidemic?—No, they were brewed in November, just at the time of the epidemic. I have

Mr. F. Scudder,
26 Mar. 1901

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cacodylate

Application
of above test
to beer.

Quantities
determined
in beer.

Mr. J. Scudder. the results of fifteen samples analysed of beers that were brewed on the 5th, 7th, 12th, 13th, 20th, 22nd, 23rd, and 26th of November, December 8th, and December 11th. Those beers varied. Six contained less than 1-100th part of a grain, two contained '084 of a grain, one '21, one '28, one '35, three '42, and one '7 per gallon.

By this test no beer found free?—Not absolutely free.

4303. You have not found any beer absolutely free?—Not absolutely free. I have examined since January, 1901, about a dozen samples of beer purchased at public-houses, and found the amount of arsenic varying from 1-70th of a grain down to 1-200th part of a grain.

4304. Have you tested glucose for arsenic by your test?—Yes. I have tested six samples of glucose, and found them all practically free from arsenic. Six different samples were sent in to me by brewers for report. I operated upon 25 grammes of glucose, and the largest amount of arsenic I found is represented in that mirror, which is for all intents and purposes practically free. (*Mirror produced.*)

4305. (Professor Thorpe.) That 25 grammes of glucose is absolutely incommensurate with 1 cubic centimetre of beer?—Certainly; you cannot get a glucose in the market that has any arsenic in it now. My difficulty has been to get hold of the contaminated glucose. They will not part with it.

4306. (Chairman.) Have you tested sulphuric acid in the same way?—Yes, only I was not so interested in testing sulphuric acid, and I have no quantitative results to put forward. I have a few samples here to show. I do not attach much importance to it, except as showing that some of the purest sulphuric acid in Manchester is highly contaminated, and, on the other hand, the common acid, the commercial acid, is absolutely free from arsenic. That stands good to-day. If you go and buy sulphuric acid in Manchester you will find the commercial acid absolutely free from arsenic, and the purest contains arsenic.

4307. What do you mean by "commercial" acid? Is that the same thing as what we have heard a good deal of—B.O.V.?—Yes.

4308. And that is?—Absolutely free from arsenic.

4309. (Dr. Whitelegge.) Do you account for that as owing to it being purified?—I account for it simply because it is acid made from spent oxide.

4310. (Chairman.) Not made from pyrites?—Not made from pyrites.

4311. You have never examined an acid that is made from pyrites that has been free from arsenic?—No.

4312. Not even when it has been purified?—No, and if it has been re-distilled it is not free from arsenic.

4313. (Dr. Whitelegge.) I see you take 53 cubic centimetres as your standard quantity of acid?—Yes, those were done some time ago.

4314. (Professor Thorpe.) Let us be quite clear about this. Do you mean to say that practically all the commercial acid in Manchester is made from spent oxide?—No, what I mean is this, that if you were to send round to druggists for a Winchester quart of sulphuric acid, commercial, you would get it absolutely free from arsenic; but if you were to send round for re-distilled acid you would find arsenic present.

4315. We ask for an explanation of that, and you say it is because commercial acid is made from spent oxide?—I expect the commercial acid we have in Manchester has been made from oxide. That is the only reason I can give to account for it. I have examined a good many samples of sulphuric acid, made from spent oxide, and they were, as a matter of fact, free from arsenic.

4316. Did you examine any malt by your process? I have examined a few samples of malt and also maize. The samples of maize were free from arsenic; the malt samples were, on the whole, free from arsenic, but one was badly contaminated, and the mirror produced from 25 grammes is shown. I did not make a quantitative analysis. That is the largest amount of arsenic I found in any malt. (*Producing sample.*)

Arsenic in malt.

4316.* (*Dr. Whitelegge.*) How much malt did you take?—25 grammes.

4317. (Professor Thorpe.) There again the amount of malt you take is absolutely incommensurate with a cubic centimetre, or even with 25 cubic centimetres of

beer?—Yes. I have shown those to other analysts, who say, "We have samples of malt that will give quite a black tube"; but I have failed to have any samples sent to my laboratory. I have asked for them, and they have been promised, but they have never arrived.

4318. Why, inasmuch as you are dealing with 25 cubic centimetres of beer, do you take an apparatus of those dimensions? Why is it necessary to take a thing which, at least in volume, holds perhaps 150 or 200 cubic centimetres?—There are two reasons for that, the first reason being that these beers are very liable to frothing.

4319. Even when you boil them?—Even after you boil the alcohol off there is still some liability to froth. Therefore a space is provided for the frothing. In the second place, and this is the more important reason, the arseniuretted hydrogen accumulates in the reducer. It acts as a little reservoir, and when you turn on your outside hydrogen you can send over the arseniuretted hydrogen in a condensed form for deposition in the tube.

4320. (Chairman.) Have you compared your tests with Reinsch's tests?—Yes. Of course, the Marsh test is far more reliable and delicate than the Reinsch test. I am not at all satisfied with the results of the Reinsch test, and cannot trust it. It has failed in several instances to detect arsenic in beer where the amount was something like 1-20th of a grain, and the erratic results which I have obtained from the Reinsch test made me discard it as a trustworthy test.

4321. Have you any explanation to suggest why it fails sometimes?—I have tested the method recommended by the Expert Committee of the Brewers' Association. In carrying out the Reinsch test they advise the use of a certain area of copper foil to 200 cubic centimetres of beer. The piece of copper foil they recommend is that size. (*Indicating $\frac{1}{2}'' \times \frac{1}{2}''$.)* You take the arsenical beer acidified with hydrochloric acid and place a piece of copper foil that size in the boiling mixture. They recommend boiling for 45 minutes. You boil it for 45 minutes, and you take it out. That piece of copper has not been capable of absorbing the whole of the arsenic in the solution. If you put a second piece in and again heat for a time you would get more arsenic deposited on the copper. If you are going to attempt to make the Reinsch test useful you must take an adequate area of copper foil. I find that $1'' \times \frac{1}{2}''$ gives much superior results. In working with the Reinsch test where I have failed to get the arsenic deposited on the copper, I have taken the liquid after it has been boiled with the copper and obtained mirrors quite distinct with the Marsh test. (*Mirrors exhibited.*)

4322. Your modified Marsh test?—The modified Marsh test. That being so, of course, it is not at all a method that will compare favourably with the Marsh test.

4323. (Dr. Whitelegge.) Your experience does not confirm what we were told, that the Expert Committee test would distinguish between 1-50th and 1-100th?—No. Most of these beers contain sulphurous acid.

4323.* What is the action when you put copper into that?—It turns black almost immediately, and the arsenic will not deposit on it. I have tried my best to make a success of the Reinsch test, but I cannot make it. It has failed in many important instances in the examination of beer, and never once has the Marsh test failed.

4324. (Professor Thorpe.) If that beer is boiled with hydrochloric acid, what becomes of the sulphurous acid which is in the preservative?—Of course, it will be evolved.

4325. Therefore it does not prevent the deposition of the arsenic?—Well, all the sulphurous acid is not evolved when you put the piece of copper in after bringing the liquid to the boiling point, and it immediately goes black. If you take a little bi-sulphite and do that your copper will go black at once.

4326. You are not aware that as the Expert Committee's test is worked it is quite possible to get results even with the presence of sulphurous acid?—It is possible to get results, but you get erratic results; sometimes you fail to get it.

4327. Have you any experience of Gutzeit's test?—Yes, I consider it a superior test to that of Reinsch's, but I do not care for it as a quantitative test, as the resulting stains fade very soon, and cannot be retained for exhibition in Court cases.

4328. Have you ever met with red mirrors, which suggested the presence of selenium, in the course of your Marsh tests?—No, I have never met with any

No selen mirrors with in tests.

Mr. Scudder. mirrors that would suggest selenium. Selenium deposits from seleniuretted hydrogen at very low temperature (150 deg. up to 270 deg.). At a red heat it passes on undecomposed and can be detected at the point of ignition on a cold porcelain basin. Arsenic is only deposited from arseniuretted hydrogen at a higher temperature (red heat). If selenious acid is introduced into a Marsh reducer the selenium is deposited as a red powder, and I have failed to detect selenium with the Marsh apparatus unless when the selenium is added as a selenide and when no reducing agent as magnesium is present. Those are selenium mirrors produced from seleniuretted hydrogen. (*Producing mirrors.*) It has been suggested that sulphur might interfere with Marsh mirrors. Here is a set of mirrors produced from sulphur alone, showing they are quite distinct, and cannot be confounded with the arsenic mirrors, nor do I find that selenium in the generator interferes with the evolution of arseniuretted hydrogen. I have taken definite amounts of arsenious acid and recovered the arsenic mirrors equivalent to the mirrors that are used as standards. You could not get selenium and arsenic to lie together in a mirror.

Mr. Scudder. 26 Mar. 1901.

4329. (*Professor Thorpe.*) No, but they lie one in front of the other. Have you not noticed that?—I have not noticed that. In my case the seleniuretted hydrogen came out, and I found it at the point of ignition, and could get it deposited on a porcelain basin.

4330. But you do not find it near the red-hot flame with which you heat the tube, with the arsenic after it, do you. You do not find it like that?—No.

NINTH DAY.

AT THE TOWN HALL, MANCHESTER.

Friday, 29th March, 1901.

PRESENT:

The Right Hon. LORD KELVIN (in the Chair).

Sir WILLIAM CHURCH.

Dr. WHITELEGGE.

Mr. COSMO BONSOR.

Dr. BUCHANAN, *Secretary.*

Dr. JUDSON S. BURY, called; and Examined.

Dr. Bury. 4331. (*Chairman.*) You are physician to the Manchester Royal Infirmary?—Yes.

4332. And have you made a special study of neuritis?—Yes.

4333. And have you written on the subject?—Yes.

4334. Papers in medical journals?—Dr. Ross, many years ago, began a series of articles on peripheral neuritis that were published in the Manchester Medical Chronicle. After his death his friends and his widow asked me to complete them, and I completed them, and they were published in book form—a separate book called "A Treatise on Peripheral Neuritis," published by Griffin and Company.

4335. You are the author?—Joint author with the late Dr. Ross. The book was published in our two names; I wrote the latter half.

4336. You have been familiar with alcoholic neuritis?—Yes. I also wrote the article on "Peripheral Neuritis" in Professor Clifford Allbutt's "System of Medicine."

4337. You have been familiar with alcoholic neuritis in Manchester?—Yes, for many years—for 15 years.

4338. Do you distinguish between alcoholic neuritis as a particular variety of peripheral neuritis?—Yes.

4339. Does alcoholic neuritis essentially belong to peripheral neuritis?—Yes. We regarded it as one of the varieties of peripheral neuritis, alcohol being one of the chief causes of the condition known as peripheral neuritis.

4340. Have you seen cases during the recent epidemic?—Yes, I have seen a good number.

4341. And do you consider that they differ in clinical aspect from alcoholic neuritis?—Yes, I do. Are you referring to the aspect of the cases generally, including the skin lesions.

4342. Yes, the cases that have occurred during the recent epidemic, the remarkable cases?—Yes; they differ, so far as I can remember, from the old cases that we saw before last year. They were what we called alcoholic neuritis.

4343. Did the cases during the recent epidemic differ conspicuously from what you formerly knew as alcoholic neuritis?—A great many of them did, not all.

4344. Do you think that some of the old cases of alcoholic neuritis may possibly have been due to arsenical poisoning?—I think it is possible, but I do not think that a scientific assertion one way or the other could be made at present. One may have one's leanings towards one view, but I do not think that the evidence is sufficient to make a definite statement.

4345. Has there been any neuritis, peripheral or alcoholic, or other special neuritis noticed in Manchester different from what might be found or has been recorded in other towns?—The alcoholic variety has been, so far as I know, very prevalent in Manchester and the neighbourhood, as compared with other towns.

4346. More prevalent in Manchester, for instance, than Edinburgh or Glasgow?—I believe so.

4347. Have you noticed a statement by Sir William Gairdner, the late Professor of the University of Glasgow, regarding cases of neuritis in Manchester of about 15 years ago?—Yes. I heard the letter read.

4348. Were you present in London?—Yes. I was present at the discussion at the Royal Medico-Chirurgical Society.

4349. But not at the meeting of this Commission?—No. The same letter was quoted at the Society.

4350. Does that letter strike you as proving there was this arsenical neuritis, that these cases may have been of the same character as those which have become so prominent during the recent epidemic?—Do I understand you to mean: is that a proof that the cases in Manchester were more likely to be arsenical?

4351. It would have a bearing on that. In respect of symptoms, do you consider that these cases presented symptoms analogous to the recent cases—that these cases noticed by Sir William Gairdner presented close analogies with some of the recent cases that have attracted so much attention?—I do not know that Sir William Gairdner in his letter did refer to that. He rather referred to the absence of cases in Glasgow, I think.

4352. (*Dr. Whitelegge.*) He referred to cases he saw in Manchester?—Yes.

4353. (*Chairman.*) I meant the cases in Manchester to which he refers. Dr. Ross was your colleague?—Yes—he showed some cases to Sir William in Manchester.

Mr. Scudder. 26 Mar. 1901.

Dr. J. S. Bury. 29 Mar. 1901.

Undue prevalence of alcoholic neuritis in Manchester before epidemic.

Dr.
J. E. Burg.
29 Mar. 1901.

4354. It appeared to Sir William Gairdner that those cases with which he was struck in Manchester, and of which he did not know analogues in Scotland, may have been of the same character as some of those which have attracted so much attention in the recent epidemic?—That is not a very easy question to answer. Of course, in answering it one has to speak on the whole question as to the past existence of real alcoholic neuritis, and that would lead one to speak of differences that occur to one between the old cases and those of the present epidemic.

4355. Have you noticed the diagram in Dr. Tattersall's report? On the extreme left of the diagram there is a red line, a 20th part of the height of that which occurs in 1900. That seems to indicate that the cases so marked and numerous in 1900 were of the same character as cases that appeared in much smaller numbers for many years before?—Of the same character, I assume, as regards the existence of multiple neuritis; that is, that they were all cases of multiple neuritis—multiple peripheral neuritis. That is another name for it.

4356. Is multiple neuritis a kind of peripheral neuritis, or does multiple neuritis mean the same thing as peripheral neuritis?—The name "multiple" is added to express the idea that a great number of the peripheral nerves are affected. Peripheral neuritis might be applied to disease of a single nerve. The term "multiple" is added to make the title more explicit. Dr. Tattersall's diagram simply refers to the number of cases at different periods of multiple peripheral neuritis, but does not refer to the cause at all.

4357. Was there any suspicion that the special cases, of which five or six were brought before Sir William Gairdner, in Manchester, had anything to do with arsenic?—There was no suspicion then.

4358. And there was no suspicion that the cases indicated on the left-hand side of Dr. Tattersall's diagram—that is to say, between the year 1890 and 1893—had anything to do with arsenic?—No, no suspicion whatever, so far as I know. In fact, up to last year all the cases in which alcoholic beverages had been taken to a considerable extent were put down as alcoholic neuritis. Of course, there are many other causes of peripheral neuritis.

may have
been partly
due to
arsenic.

4359. In the light of recent events we attribute a large proportion of what is represented by this red line for the year 1900; we now know from evidence that it is a thoroughly well founded opinion that a large proportion of these cases are due to arsenic?—Some, no doubt; possibly a large proportion, but not necessarily all.

4360. That is to say, some of these cases might be alcoholic neuritis independently of arsenic?—In my opinion, yes.

4361. Or neuritis from some other causes than alcohol?—Possibly.

4362. Some other cause different from either alcohol or arsenic?—Possibly, but more likely to be alcohol without any arsenic.

4363. Judging from the light given since the end of the year 1900, do you think it probable that some of those older cases of peripheral neuritis were probably due to arsenic?—No, I do not consider it probable; I consider it possible.

4364. You do not think that the recent experience makes it probable that some proportion of those were due to arsenic?—I do not think so; I do not think it is probable.

4365. Have you any conjecture or explanation to give us?—In the first place, the late Dr. Ross, who was working very diligently at the subject between 1887 and 1890, when I was working with him, took very great care to record all the symptoms presented by the patients in the infirmary who had peripheral neuritis, and I find it difficult to conceive that any marked skin lesions would have escaped our observation.

Skin lesions.

4366. The skin lesions you take as one of the symptoms essential to the probability of arsenic?—Yes, essential to the probability. I do not say that arsenical neuritis might not exist without skin lesions, but at any rate that would be one of the main things on which our diagnosis would be based.

4367. Can you suggest any reason for the great prevalence of one form of peripheral neuritis 15 years ago in Manchester as noticed by Sir William Gairdner—the fact of that being so comparatively frequent in Manchester and non-existent, so far as known, in Scotland? Can it be due to the national alcoholic beverage in Scotland, whisky, and the alcoholic beverage in this part of

England, which I suppose may be called beer?—That I cannot answer, except that they take enormous quantities of beer in this district.

Dr.
J. S. E.
29 Mar.

4368. And enormous quantities of whisky sometimes in places in Scotland?—Probably they would not be able to continue work so well if they took a proportionate amount of whisky here. Beer is the more diluted form of alcohol. Still, I could not answer that question.

4369. I wish to find out whether you consider that the facts make it probable that there may have been occasionally arsenic in beer in Manchester as an exciting cause of these illnesses, and that the fact of these illnesses being comparatively frequent in Manchester and infrequent, or non-existent, in Scotland may be due to the comparative rarity of beer-drinking in Scotland and the reverse in the middle of England?—I consider it probable that arsenic might occasionally have been the cause.

4370. The difference being beer with arsenic in Manchester and not in Glasgow or Edinburgh; but you could not say you think it probable from your own experience and knowledge?—No, I should not care to give a definite answer to that, because it is rather outside the scope of evidence that one has had before one. It is only a speculation.

4371. At most any such opinion would be merely conjectural?—I think so.

4372. Can you give us particulars of some of the cases that you have seen?—I went over the cases of peripheral neuritis that I had in my own wards last year. The numbers are: One in January; then no case until July; two in July, four in August, one in September, five in November, and eight in December. Those numbers refer to the admissions of patients to my wards at the Infirmary.

4373. Do you distinguish those cases from cases which you previously had?—Some of them, undoubtedly.

4374. Of the whole number you have mentioned some of them are not absolutely distinct from what you had known before?—Probably not.

4375. Do you think that alcohol itself was the essential cause of the alcoholic neuritis cases with which you were familiar before the epidemic?—I think that the evidence points in that direction.

4376. Can you give instances of so-called alcoholic neuritis in persons drinking spirits and no beer?—Yes, I have seen it in sailors who have taken rum chiefly. Of course, it is difficult to exclude other beverages; one cannot always get authentic information. But at any rate in sailors who have alleged they have taken principally rum, I have seen it, and in ladies who have taken brandy only, and I have seen it in whisky drinkers too.

4377. Do you attribute the illness to the effects of alcohol in these cases?—I have done, and I am still inclined to do so. There may be arsenic in some of the spirits that have been taken, but I should be inclined at present to attribute the neuritis to the alcohol. There are a few collateral lines of evidence in that respect. The late Dr. Ross in his collection of cases—77 cases he had collected from the literature of alcoholic neuritis—found that in 22 of these large quantities of spirit, and spirit only, were given in the histories of the patients.

4378. One-third of the whole number?—Yes. Then some individuals after taking a very small quantity of spirits or wine will suffer from a very slight form of peripheral neuritis—from numbness and tingling—a day or two afterwards, or the next day. That is slight evidence to suggest that alcohol affects the peripheral nerves or tends to affect them.

4379. Were these disturbances you mention due to excessive use of alcohol for a day or two, or only to a small quantity?—I mean a single glass.

4380. A single glass of whisky or spirits has produced the effects you now describe?—Of course, it is only fair to say that some of the patients I have referred to were gouty individuals, so that it is very difficult to eliminate a gouty tendency.

4381. Persons not drinking from day to day have had the experience?—The late Dr. Ross was very fond of quoting one case in which a patient of his, after a single glass of wine, would have not only numbness and tingling at the extremities, but his nails would begin to crack.

4382. Time after time on the same individual?—I believe so, so far as I remember. I know he quoted that case in the wards very often.

Clinical
differen-
between
arsenic
alcohol
neuritis
always
apparent

Alcohol
neuritis
in spirit
drinkers

Dr. Bury. 4383. (Sir William Church.) Lord Kelvin directed your attention to this diagram, and pressed you about it. When was the term "alcoholic neuritis" used commonly in Manchester in your registers?—Ever since I became connected with the infirmary in 1885. I became medical registrar to the infirmary in that year, and the term was used then, or at any rate a year afterwards.

4384. Do you remember when it was first introduced into the nomenclature of disease. As a matter of fact it was at that date. It was not in the nomenclature before 1885?—No; but papers were written with that title.

4385. Yes, but it did not go on the register?—I did not know that.

4386. That being the case it is quite possible that cases would have been only put down as alcoholism without the form being mentioned?—Yes.

4387. So that some of this gradual increase may be due rather to the use of the term than to an increase in the disease?—Quite so. I am not sure whether you have had the figures from the infirmary of cases during the last 10 years?

4388. Yes, we have. Lord Kelvin pressed you also rather about the condition of the population who exceed in alcohol in other parts of the kingdom, but is it not the fact that there are other effects of alcohol besides peripheral neuritis?—Yes.

4389. Is it not the case that these effects are found to differ a good deal in different parts of the kingdom? For instance, what I have in my mind is cirrhosis of the liver, gin drinkers' liver, which is said to be almost unknown in Scotland, or very rare?—I do not know.

4390. It is not met with in the post-mortem room of Edinburgh or Glasgow?—I think I have heard it said so.

4391. Gin drinkers' liver is usually attributable to alcohol, is it not?—Yes.

4392. Therefore, it is possible, though we do not know much about it, that the effects of alcohol in different beverages may be slightly different on the system?—Quite so.

4393. Did the milder cases of what are supposed to be arsenical neuritis that you have seen during the past year differ in any respects from what you would have considered alcoholic neuritis formerly, where there was no pigmentation or rashes?—I think that type cases of arsenical neuritis differ from alcoholic neuritis.

4394. I wish to leave out the typical cases?—I mean leaving out the skin lesions, and simply referring to the paralytic symptoms. To begin with, the sensory symptoms, I think the cutaneous hyperesthesia is certainly more severe and more persistent than in cases occurring before this epidemic.

4395. That is what I had present in my mind. I have seen some of these cases; to me the hyperesthesia was very much greater than anything I have seen before?—Before coming here I referred to Dr. Ross's account again, and he makes a special note of that fact in giving the clinical symptoms of alcoholic neuritis; he says that cutaneous hyperesthesia although present is always subordinate to muscular hyperesthesia in the alcoholic cases. That is in accordance with my own memory of the old cases. In the cases that I have studied carefully in my wards the cutaneous hyperesthesia has been something remarkable, and in one or two cases one of the most remarkable things I know in clinical medicine. To give you an example. A man came into my wards in February of this year. He had been under hospital treatment since last May in Halifax. He had been a fairly heavy drinker. He has been in hospital practically ever since, and he certainly had not had access to any alcoholic beverage. When he was under my care, between February and March, there was very little motor paralysis. He stated that when he was in Halifax he had complete motor paralysis. He recovered from that, and the only remaining symptom was the excessive hyperesthesia. Stroking the sole of the foot gave him agonising pain, and the sole of the foot was also red. There was not a shadow of suspicion that there was anything of a hysterical nature about him. The nails were intensely tender, so that the slightest pinch would cause him the greatest pain. It reminded me very much of touching the exposed nerve of a tooth from the suddenness of the shock of pain. For a fortnight, while he was in the infirmary, these symptoms seemed to get worse. We sent him out to the Cheadle Convalescent Hospital in

much the same state. Here then is a man who has been at rest in bed since last May, in whom there appears to be no improvement whatever in the severity of the cutaneous hyperesthesia. It seems as if the ends of the nerves were exposed or bulbous, or in some unusual condition.

4396. (Chairman.) Is he still in hospital?—Yes, at the convalescent hospital at Cheadle. I certainly do not remember anything approaching that in the old cases. To a modified degree it is also one of the notable features of other cases.

4397. (Sir William Church.) Both the sensitiveness of the skin and also the pain upon making pressure upon the muscular tissues is very much greater than in the older cases?—Yes; I do not feel so confident about the muscular hyperesthesia, but I think we should have remembered the cutaneous. I have never seen anything like this before.

4398. (Chairman.) Is this probably due to arsenic?—I think so, because the man had some scaliness of the hands and feet when he came in, and the redness has persisted. With regard to the distinctions, that is one marked thing, the cutaneous hyperesthesia. With regard to the motor symptoms, I think that they also are different. There is a far greater tendency to active spasm of muscles, much greater than I ever remember seeing in the old cases. In fact, so struck was I with one case in the past of active spasm of muscles that I remember especially drawing attention to it in the book. It was a case in which the hands somewhat resembled the aspect of tetany, but in most of the alcoholic cases, so far as I remember, the condition of the hands was a loose one. The wrist was dropped, and the fingers were more or less loose, so that you could test them in various ways. In the majority of the present cases the condition of active spasm is a very noticeable feature. The typical arsenic hand is a distinctly curled one, with marked contracture.

4399. Is that an old, known symptom of arsenical poisoning?—Yes, the contractions are, rather laid stress on in some of the accounts. I think Raymond, a French writer, lays stress on them. Then the extensors of the fingers are certainly more affected than in the alcoholic cases. Some of the cases which are distinctly arsenical, as proved by the skin lesions, I have tested over and over again. They can move their wrists a little, but the paralysis of the extensors of the fingers is complete. I am inclined to think that is a difference, and I find that Professor Raymond also mentions it in his account. Then the contractures are more marked. I have a man now in whom supination is impossible, owing to marked contracture of the pronator radii teres.

4400. (Sir William Church.) Contraction of the lower limbs, too, is not infrequent?—I do not like to speak too positively, because it is difficult to remember old cases, but I certainly think active spasm is a more marked feature in the present cases and contractures too are more common. Coming to the associated symptoms, especially to the mental condition, I think there is a very marked difference. In the present cases, although you meet with mental disturbance, it is nothing like the degree of that met with in the real alcoholic cases, where failure of memory for time and place, and chronic delirium are conspicuous features.

4401. Many of these cases would be probably mixed; they would be suffering both from alcohol and arsenic, so that that would account for a good many having the mental symptoms very similar to what we have associated with alcoholic neuritis before?—I quite agree. In my opinion three varieties may be distinguished—pure alcoholic cases, mixed cases, and pure arsenic cases. I was very much interested in talking to the sister of my ward—a woman of very great experience and a very acute observer—and she spontaneously referred to the difference as regards the mental type in these cases.

4402. Did you notice any other symptoms in these cases which you associated with arsenicated beer which differed at all from what you had previously been accustomed to associate with alcoholic neuritis in the condition of the other viscera?—In one of my cases the bladder and rectum were markedly affected, which I believe is almost unknown in alcoholic cases. With regard to the heart, I should be inclined to think that we had more cases of dilatation of the heart in the past, but I think that is a much more doubtful subject. Furthermore, there is a greater tendency to point affections in the arsenical cases.

Dr.
J. S. Bury,
29 Mar. 1901

Mental disturbances less in arsenical cases.

Dr.
J. S. Bury.
29-Mar. 1901.

4403. I was thinking more especially of the liver?—Our experience of what we call the alcoholic liver has been that it is a large liver, fatty, with some interstitial tissue, and that the small hard liver is rare in Manchester.

Atrophy
of muscles.

4404. With regard to the cases of the last year, have the large proportion of them had enlarged livers, or a smaller proportion?—A smaller proportion I should be inclined to say. There are just one or two other details with regard to the symptoms. I think the atrophy is more marked, and there is more tendency to a general wasting in the arsenic cases. They are often thinner and more wasted, and the atrophy is more widespread.

4405. Still, a good many of these cases did not seem to have lost fatty tissue; the paralysed muscles are wasted?—More generalised muscular atrophy. I think muscular atrophy was more localised in the old cases.

4406. Have you any suspicion of any other disease? It has been suggested, for instance, that some of these may be the results of influenza?—I do not think so for a moment.

Admission to
Manchester
R. Infirmary
of neuritis
patients.

4407. You appear, during the last year, to have had 21 cases under your own care in the infirmary?—Yes, there were 62 cases in the wards, and I had 21 of them.

4408. What would be the total number of admissions to your wards during that time?—I could not tell you that.

4409. Perhaps I can get at it in a different way. Could you tell me what would be your average number of admissions from alcoholic neuritis in former years?—The total number varied from 20 to 37 in the hospital. I should probably have about a third of them.

4410. Seven or eight a year?—There are four physicians, and the two assistant physicians have three or four beds each. I usually get about a third of the nervous cases, as far as I remember, so that that would be an average of eight to ten roughly. I should not think more.

4411. Accepting the suggestion that they had drunk more beer in Manchester and Liverpool than they had in the South, you have no other explanation to offer for what appears to be very remarkable; that is, the much greater frequency of alcoholic neuritis here than in London, for instance?—No.

4412. What proportion do you think your in-patients with this affection bore to the out-patients? I suppose a large number of milder cases of peripheral neuritis or alcoholic neuritis would be treated as out-patients?—Yes. I do not know what the proportion is.

4413. You could not tell us what increase there has been in the milder cases during the past year?—No. I have had nothing to do with the out-patients for the last two years. Before that I was in the out-patient department as assistant physician for some years. They did not occur every week, even in the out-patients' room.

4414. (Dr. Whitelegge.) Have you seen many cases outside the infirmary?—I have seen several cases.

Pigmentation
in neuritis
cases in 1900
and before.

4415. In the cases which were observed and recorded by Dr. Ross and yourself, I understand there was no instance of pigmentation?—There is none recorded in Dr. Ross's account, and I do not remember any. I certainly have no recollection whatever of pigmentation.

4416. Before 1900?—No.

4417. In the cases you have observed in 1900, pigmentation is frequent, is it not?—It is not so frequent as the scaliness of the hands and feet, and often has to be very carefully looked for. The first case I had in November was one of the most marked cases in the epidemic, the man's skin was a deep bronze tint. I have examined the skins very carefully since then. Many of them are slightly pigmented, but in others pigmentation is not easy to find. The keratosis of the hands and feet was the most important skin lesion.

4418. The pigmentation you would regard as a point of distinction, although not always occurring, between the two types?—Yes.

Keratosis.

4419. Was keratosis observed in the old alcoholic cases?—It is not mentioned in Dr. Ross's cases, and I have no recollection of it. I also asked the sister I have referred to, and she does not remember it at all.

4420. Before the recent epidemic, was arsenic familiar as a cause of neuritis?—Yes.

Toxic effect
of arsenic
increased by
alcohol.

4421. Do you hesitate to give arsenic to alcoholic patients? Do you regard alcoholism as predisposing to

arsenical mischief?—I think it is very likely. The two drugs appear to pick out similar parts. I think it is very likely that a stimulant like alcohol would help arsenic, or that they would be of mutual assistance.

4422. Are those cases which you regard as distinctly arsenical more prevalent in women than in men?—I could not say, because I have only had a limited number of cases under my own observation, and I have not gone into the statistics. With regard to the old cases, the bad cases were certainly more common in women in hospital practice.

4423. (Chairman.) Before the recent epidemic?—Yes. But the milder and moderate cases I should think were just as common in men.

4424. (Dr. Whitelegge.) You are referring to the alcoholic cases?—Yes, the old cases.

4425. Do you assign any reason for that?—The occupation of a man tends to prevent continuous drinking; a woman left at home can give up the whole day to it if she likes. Then, of course, the effect of being out of doors will tend to the quicker elimination of alcohol.

4426. And you attribute the difference to these causes not to any constitutional predisposition?—I think the causes I have mentioned are more likely.

4427. Do you attribute a considerable part of the recent epidemic to arsenic?—Yes.

4428. But not the whole of it?—No. Nor do I think it is at present easy to speak positively with regard to many of the paralytic symptoms, as to how far they are due to alcohol or to arsenic. I wish to speak in a perfectly unbiassed way about it, simply referring to the evidence we have.

4429. (Chairman.) Was there any special reason for the increase of non-arsenical alcoholic cases in 1901?—I should not like to say they have been increased.

4430. So that the extra number in the recent epidemic is probably due to arsenic?—Yes; although, of course, it may be that alcohol has helped.

4431. Arsenic with alcohol may have caused the increase?—Possibly.

4432. (Dr. Whitelegge.) You have followed what has been said about the quantity of arsenic in beer?—Yes.

4433. Does it appear to you that the amount of arsenic that has been found in beer would be sufficient in ordinary circumstances to give rise to the symptoms now attributed to arsenical poisoning?—Certainly, in a large number of cases, because there has been really a large quantity of arsenic.

4434. The dose was adequate?—Yes. In a large number of cases, where the dose has been small, it is difficult to say. Take a dose of, say, 1-20th of a grain in a gallon; that is equivalent to 5 minims of liquor arsenicalis in 8 pints. A dose of that sort I should regard as a kind of borderland dose. It would be very difficult to say whether 2½ minims of liquor arsenicalis twice a day taken for many months would produce symptoms.

4435. You might also suspect in these cases a larger dose than the chemist had found?—Yes, I think it is very likely. Of course, the question with regard to the past depends on the possibility of small doses of arsenic having produced some of the symptoms, and that I find very difficult to answer.

4436. (Chairman.) We have had cases given in evidence in which the beer consumed was alleged to be from a pint to two pints—not more than two pints. Do you think that 1-50th of a grain in such circumstances could be detrimental?—I should not think it is at all likely.

4437. Taken day after day, week after week?—It would be rather against our experience of medicinal doses, that is, only half a minim of liquor arsenicalis. We usually begin with about 3 minims. Thus 1-50th of a grain would be one-sixth of an ordinary minimal dose.

4438. Two pints per day under those circumstances would be a very small dose?—I think so. It is only fair to say that one might be sceptical about the "one or two" pints as well as about the quantity of arsenic.

4439. It is also possible that in those cases, if the patient was truthful, it might have been some of the worst specimens of beer?—Certainly. I think it is quite possible there may have been much more arsenic in some of the beers than has been imagined; but I have taken great pains in the cases I have had, where

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J. S. there has been a doubt as to the quantity of beer taken, to make careful enquiries, and I have never satisfied myself in a single case that a small quantity of beer has been taken. In one case, in which a small quantity was alleged, I had the friends down to my consulting room and asked them, and they said it was quite correct, that the man had never taken more than one or two pints at most. Then I found he had held an important position in a bank some years ago, and I could not get an adequate reason for his leaving. I asked his wife, "I suppose he did not get intoxicated?" and she said, "Oh, yes, he got intoxicated." I said, "How often? Once a week?" and she said, "Sometimes oftener than that." So it is very difficult indeed to get accurate accounts with regard to the amount taken.

4440. In many cases the patient's allegation of extreme moderation is not true?—Hardly ever.

4441. Have you looked at all into the quantitative analyses that different chemists have given?—I have read them over.

Mr. CARTER BELL, called; and Examined.

C. Bell. 4443. (Chairman.) You are an Associate of the Royal School of Mines?—I am.

4449. And you have had many years' practice as an analyst?—About forty.

4450. You are also analyst for the County of Chester and for several boroughs?—Yes, Salford, Birkenhead, Stalybridge, Congleton, and Glossop.

4451. During the quarter ending December 31st, 1900, you analysed many samples of beer?—Yes, I have analysed for the County of Chester in that time 82 beers and 30 of those contained arsenic. For Salford I analysed 58 beers and 7 of those contained arsenic. For Stalybridge I analysed 7 beers, and 4 contained arsenic; for Birkenhead I analysed 29 samples and 11 contained arsenic; for Glossop 21 beers and 8 contained arsenic; for Congleton no samples were sent in at all. I may say that the Corporation of Warrington—I am not their analyst—sent to me, and I analysed a considerable number for them, and some of their beers did contain traces of arsenic.

4452. Eighty-two samples from the county of Chester, and 30 of them contained arsenic. What quantity of arsenic?—The quantity was not estimated in every case, but I estimate that it varied from 1-10th to 1-50th or 1-100th of a grain per gallon, but I may say that those were not estimated very accurately simply for the reason that so many samples came in that I had to do them very quickly, and I used to write off to the inspectors and tell them to stop the sale of that beer at once. As we went on the authorities wrote to me to say that no prosecutions were taking place, and therefore there was no necessity, when they had stopped the sale of the beer, for further investigations of those samples.

4453. (Dr. Whitelegge.) Did you take steps to stop the sale of the beer irrespective of the amount of arsenic you found?—Not in the 1-100th of a grain I should not, but where I found 1-10th, or, as I considered, over a tenth of a grain, I wrote to the inspectors at once, and told them that they must stop the beer at once.

4454. (Mr. Cosmo Bonsor.) Is that the inspector under the Sale of Food and Drugs Act?—Yes.

4455. (Chairman.) Were some of the arsenical samples of beer those in which Bostock sugar had been used?—They were.

4456. Did you find more than 1-10th of a grain of arsenic in some of these?—Yes, I should say there was more than 1-10th.

4457. During this quarter you have examined 128 samples from the County of Chester, of which 19 contained arsenic?—That is this present quarter. I have analysed already this quarter, the quarter which will end on the 31st March, 128 samples, and 19 have contained arsenic. Now the authorities in Cheshire have determined that in cases where arsenic is found prosecution shall take place, and we have just had one at Nantwich against a brewer and a publican, where I have certified that the beer contained 1-10th grain of arsenic to the gallon. The prosecution took place about a fortnight ago and a conviction followed.

4575.

4442. Have you any remarks to make upon them. There are great discrepancies among different chemists?—Yes.

4443. (Dr. Whitelegge.) Have you noticed considerable differences in the susceptibility to arsenic? Is it a fact that that susceptibility to arsenic varies greatly?—I should think so.

4444. Could you say what is the smallest amount you found to produce a toxic effect?—No. I could not recollect. I am thinking of the treatment of chorea cases. Toxic effects from arsenic in chorea are not very common.

4445. (Chairman.) You might meet with exceptional cases?—Yes.

4446. But you cannot give us any particular information about that?—No, except that comparatively small doses in chorea cases sometimes produce pigmentation.

4447. What kind of dose are you thinking of now?—I could not at the moment give accurate figures.

4458. (Dr. Whitelegge.) Can you say against whom the prosecution was taken?—Against the publican and the brewer.

4459. How did the brewer come into the case?—He supplied the beer; it was a tied house.

4460. Were you present at the hearing?—Yes.

4461. Was it on warranty that he was brought into the case?—No, he was summoned. There were two summonses issued, one against the publican and one against the brewer.

4462. (Mr. Cosmo Bonsor.) Is there a report of the case?—Yes, in the newspaper.

4463. Could we have it put in?—It was a fortnight ago last Monday.

4464. (Chairman.) What was the finding?—The publican was fined, I think, £2 and costs, and the brewer £30 including costs.

4465. Did it appear in the trial on what date the brewing of the beer was made?—Yes, it did. I believe the beer was supplied last quarter, and notice had been given to the publican not to sell this beer.

4466. Notwithstanding that notice he sold it?—I believe so. The excuse that the brewery people made was that they left the beer in the cellar intending the railway company to bring it back to their brewery so that they could destroy the beer, but they had so many barrels to take away at that time that it was forgotten.

4467. And the publican sold it?—It was sold to the county authorities.

4468-71. Your inspector went as a customer and bought that beer?—Our inspector sent his boy into this place, a boy about thirteen, to buy a quart of beer. The son bought the beer and paid for it; his father was in the street and the son beckoned to the father to come in, and the father said, "This beer has been bought for me for analysis, and I shall divide it out into three parts and send one part to the county analyst." That was done. I certified the beer contained 1-10th grain of arsenic to the gallon.

4472. Was it proved in the case that the publican took this from one of the condemned barrels?—Yes, it was.

4473. (Sir William Church.) On what grounds were the brewers fined the £30?—Because it was a tied house.

4474. And the publican was supposed to be acting as their servant?—Yes.

4475. Although he disobeyed their orders?—That is so.

4476. (Chairman.) The £2 was the punishment for selling beer which was known to be condemned as containing arsenic?—Yes.

4477. (Sir William Church.) I do not know whether you have the same information that we have with regard to the brewers' names, but I should like to have the name of the brewer. I will give you the list of those that we have already had evidence about. (List handed to Witness.) Is the name of that brewer there?—No.

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Mr. C. Bell. 4478. The name will have appeared in the papers?—Yes; it was the North Cheshire Brewery.

29 Mar. 1901. 4479. (*Chairman.*) We should have the reported evidence of that trial; can you send in to Dr. Buchanan the evidence?—Yes.

4480. There was no trial in the county of Chester for sales of beer during the quarter ending with 1900?—No, none.

4481. The trial you have just referred to was for sales during the first quarter of the present year?—Yes.

4482. There was a second prosecution not yet heard, I believe?—Exactly, but it is to be heard on April 17th.

4483. Your case there was the analysis of a sample purchased by the inspector?—Yes.

4484. It was supplied by the inspector to you?—Yes.

4485. What amount of beer did you take?—About 20 ounces was sent to me; about a pint.

4486. How much arsenic had you found in this case?—That I have certified as 1-30th of a grain of arsenic to the gallon.

4487. That you certified in court?—I have given it on my certificate.

4488. From the county of Chester you have also received specimens of sweets and jams?—Yes, large numbers.

4489. In any case have you found arsenic?—Not in any case.

4490. Did you use quantities such as would have shown the arsenic by the same test as that by which you found it in beer?—Exactly the same, and I found no trace at all.

4491. You also examined cheap pickles and vinegars?—Yes; but no arsenic was there.

4492. In the figures for Salford there are 58 samples of beer of which seven contained arsenic?—Yes.

4493. Up to the present date how many samples have you analysed?—Twenty up to the present date, and none of them contained arsenic.

4494. Dr. Tattersall has told us that he sent to you samples of Groves and Whitnall's beer to examine them for mineral poison?—Yes.

4495. Was that before the discovery of arsenic by Dr. Reynolds?—Yes.

4496. Did you examine those samples for mineral poison?—I did. But I may say that in reference to those samples a letter was sent to me to examine them for the higher alcohols, such as amyl alcohol. In the first samples there were six ounces, and in the next eight there were a few more ounces; by the time I had used up these 14 samples for the examination of the higher alcohols a special message came up from the Town Hall, at about 11 in the morning, asking me to examine these for arsenic. I had hardly anything left, and I was desired to get it done by 2 o'clock. It was not easy to examine 14 samples in about two hours. I immediately put what little I had in the Marsh apparatus, but it gave no indication of arsenic whatever. I went down to the Town Hall, and said I had not found any.

4497. What quantities did you have in that necessarily hurried examination?—In the first instance I had only the first six samples; there were six ounces of beer, and I was asked to analyse that for the higher alcohols. That took nearly the whole of that quantity, and I do not think I had an ounce or half an ounce left. I thought if any appreciable amount of arsenic was present one must find it by the ordinary Marsh test.

4498. Even in an ounce or half an ounce?—If there had been any dangerous quantity of arsenic I must have found it.

4499. (*Mr. Cosmo Bonsor.*) We have it in evidence there was only one quality of beer brewed by Messrs. Groves that did contain arsenic. Possibly this particular beer you were analysing had no arsenic in it?—Of course it might not. In reference to the samples, Dr. Tattersall came to me in the evening and spoke about arsenic, and I told him in this particular sample I did not find any, and asked him to come and test with me the little I had left. I could not find the arsenic.

4500. (*Chairman.*) What quantity was the last test

made with?—About one or two ounces of beer I had left.

4501. (*Dr. Whittege.*) Did you use in the application of the Marsh test exactly the same methods you would rely on at the present day to find arsenic?—No, I did not. I have altered my method considerably. Of course, one was under the impression that an ordinary Marsh test was sufficient to find out arsenic.

4502. (*Chairman.*) With regard to the Borough of Small Stalybridge, you analysed seven samples of beer?—Yes, four of which contained arsenic.

4503. What is the population of Stalybridge?—I think about 60,000 or 70,000.

4504. Is not that rather a small number of samples to be submitted to you?—Yes. They only sent me 10 a year. They are going to send more now, I believe.

4505. Have you any information as to arsenical poisoning cases in Stalybridge?—No; only from these samples, four of which contained arsenic.

4506. In considerable quantities?—No, from 1-50th of 1-100th of a grain.

4507. (*Sir William Church.*) You say that you had ten samples of beer yearly from Stalybridge?—No, 10 samples of anything—butter, or anything.

4508. Did you ever have a sample of beer from them before?—Never.

4509. (*Dr. Whittege.*) May we take it that in all these cases where you found arsenic you gave instructions which led to the stoppage of the sale?—I did.

4510. In every district?—Yes.

4511. (*Chairman.*) With regard to the Borough of Birkenhead, during the last quarter of last year how many did you analyse?—I analysed 29 samples of beer, of which 11 contained arsenic.

4512. What quantities of arsenic?—I should say some of them must have contained 1-10th of a grain of arsenic to the gallon.

4513. And some smaller quantities?—Yes.

4514. But in respect to every one of the 11 you condemned it?—Yes. But no prosecutions were taken.

4515. There was stoppage of the sale?—Yes.

4516. Do you know whether any of those samples were brewed from Bostock's sugars?—No.

4517. During the present quarter you have analysed four samples of beer from Birkenhead?—Yes, and no arsenic was found in any of them.

4518. And the borough of Glossop at the end of last year?—I analysed 21 samples of beer, of which eight contained arsenic in more or less quantities. I should think not more than 1-50th to 1-100th of a grain for the less quantities.

4519. In every case was the sale of those beers stopped?—Yes. New samples were taken, and the new samples did not contain arsenic. They stopped the sale of it and obtained new samples from the publicans. They showed no trace of arsenic.

4520. By the same tests?—Yes.

4521. On the same quantities of beer?—Yes.

4522. What about Congleton?—I have had no samples from them.

4523. Had you any reason why no samples were sent to you?—No; the Act is not enforced in Congleton.

4524. Have you received a great number of private supplies of beer malt, hops, etc.?—Yes. Some of the private samples of beer just contained mere traces of arsenic not worth speaking about, and two or three samples of malt have contained mere traces of arsenic, and the hops none.

4525. What tests have you used in these cases?—A similar test, by acting upon the malt with nitric acid and dissolving off the coating of arsenic, and then evaporating down and drying with sulphuric acid, and putting that into the Marsh apparatus.

4526. You speak of dissolving away the coating; was there a visible coating on the malt?—Only what may be called a dirt.

4527. That was malt before it had undergone brushing and screening?—That I could not say.

4528. Was it malt given to the brewer as ready for use?—Yes.

4529. You separated that crustation from the ???

No arsenic found in jams, sweets, &c.

Arsenic not detected in earliest samples of arsenical beer from Salford.

Mr. C. 29 Mar.

numbers samples food and drugs submitted to P. analysis in certain districts

No such samples Congleton 1900.

Arsenic brewing material

C. Bell. by dissolving it off?—Yes, by means of acid, and I treated that acid product in the Marsh apparatus.

ar. 1901. 4530. Then only in one sample of malt you found arsenic?—Yes. I have had two more samples since I wrote my *présis* where there were traces.

4531. How much might that be in a large quantity of malt?—It would be a most difficult thing to say. It is almost guess work.

4532. Do you consider that these traces might put enough arsenic into the beer to be dangerous?—No. This question of arsenic in malt must have been going on for years and years, because I have some samples of beer made from malt and hops in my cellar now which were sent to me about seven or eight years ago. I have just had a bottle of that analysed, and there is a trace of arsenic in that beer which was sent to me seven years ago.

4533. Were you requested seven years ago to test it for arsenic?—No. It was sent to me as a very pure beer.

4534. Had you ever heard it stated that beer sometimes contained arsenic?—Not till this epidemic.

4535. Had you no suspicion? In specimens of beer sent for analysis it would not be understood that arsenic was to be looked for?—No.

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in jam. 4536. Then a large jam manufacturer near Liverpool submitted his makes of jam to you for examination?—Yes, I have analysed jams from a very large manufactory there, and there was not a trace of arsenic in any of the samples.

4537. Did he use glucose in his jam?—I cannot say whether he did. My attention was simply drawn to whether there was arsenic or not. It was at this particular time, and he particularly wished to know if there was arsenic present.

4538. Your test could not detect glucose?—Not at that time.

4539. Could any test you could apply detect glucose in the manufactured article?—Yes.

4540. Can you distinguish by your tests between glucose and the golden syrup or treacle or molasses of natural manufacture?—Yes, I can, most easily.

4541. You have no means of telling whether those jams were made by some of Bostock's sugars?—I did not test the jams themselves for glucose, but I have done so within the last fortnight, and there was no glucose in them.

4542. Did you ask the maker of the jam if they used glucose?—No, I did not; it was made of pure cane sugar.

4543. You have no reason to think that they used the Bostock glucose?—No, and as I found pure cane sugar, I did not ask him whether he had used glucose.

4544. What is your opinion as to the cause of the traces of arsenic in beer at the present time?—I consider that all the apparatus and implements of the brewery must have been saturated with arsenic from the use of Bostock sugar, such as the barrels, indiarubber tubing, pipes; and if these were not thoroughly cleaned out, it must naturally contaminate the beer.

4545. A small residue from the use of Bostock's sugar?—Yes. Even the very copper vessels would almost act as a Beinsch test; the arsenic would be deposited upon the copper.

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ining
ewing 4546. (Sir William Church.) Have you seen the accounts of the investigation of the cleanings of the vats and barrels? You are aware that portions of the wood of vats have been cut out and examined for arsenic?—No, I was not aware of that. Was arsenic found?

4547. In hardly detectable traces?—I had a piece of indiarubber tubing sent to me from the brewery, and I passed a solution through that, and obtained arsenic.

4548. Attention has been directed to what you are now speaking of. The copper has been also searched for arsenic where Bostock's sugars have been used, and no trace was found?—One would have thought from theory that it would have been deposited on the copper, as it is one of our tests.

4549. (Chairman.) You think it desirable that a uniform method of testing beer or such like bodies for arsenic should be used?—I think there should be a uniform method of testing. At the present time every chemist has a different process. Only a short time since I had a sample of beer sent to me to examine, and I understood that one analyst had certified that it con-

4576.

tained 1-5th of a grain of arsenic to the gallon; that is, five gallons of the beer contained one grain of arsenic. I certified that 15 gallons of the beer contained one grain of arsenic. It was sent to another chemist, and he certified that 40 gallons of beer contained one grain of arsenic. It was sent to the Somerset House authorities, and they certified that 30 gallons of beer contained one grain of arsenic. So that there is some difference.

4549* A difference of from 5 to 40?—Yes.

4550. The magistrates dismissed this case you mentioned?—Yes.

4551. Why did they dismiss it?—Because the discrepancies were so great. Forty to 50 gallons of beer containing so small a quantity is not very bad.

4552. But they would not have dismissed it if all the analysts had said 40?—That I cannot say.

4553. (Dr. Whitelegge.) Did you stop the sale in every instance of beer containing above 1-40th?—Yes. I certified at once, and sent to the inspector to tell him he had better stop it.

4554. (Chairman.) Is it certain that the magistrates dismissed a case in which four analysts found over 1-40th, or more than 1-40th, of arsenic?—That is a fact.

4555. I think that really should be on record, that the magistrates dismissed a case in which four chemists certified quantities of 1-40th of a grain per gallon or more?—Yes.

4556. If there was no other reason for dismissing the case, it hardly seems as if the safety of the public was taken into account by the persons who dismissed that case. Have other cases been brought before you?—There is another case I have just had before me, where a summons was taken out against a brewer for a trace of arsenic of about 1-100th grain per gallon. I examined it by my method and found the quantity was exceedingly slight, so slight that I should have practically passed it as a pure beer.

4557. Has this case gone forward?—It was to have come on on Monday, but I have not heard the result of this case.

4558. Was that submitted to the same magistrates as those who tried the previous case?—No; this one is in Wales.

4559. (Mr. Cosmo Benson.) Where was the other one where the magistrates dismissed the case?—Near Rochdale, I think.

4560. Was it a bench or a stipendiary?—A bench.

4561. (Dr. Whitelegge.) Your certificate was an official one?—No. This is not my official certificate. I am simply requested to analyse as against the official certificate. The county analyst gave this case as 1-5th of a grain of arsenic to the gallon; it was sent to another analyst, who found 1-40th. It was then sent to me, and I found 1-15th. It was then sent to Somerset House, who found 1-30th.

4562. (Sir William Church.) But in this case, in which proceedings have been taken, in which you found only 1-100th of a grain, do you know whether any chemist found a higher percentage?—No; he could not state the quantity, it was so infinitesimal. I saw the certificate, and there was no mention of any quantity.

4563. And yet proceedings were taken?—Yes. He could not estimate the quantity.

4564. (Chairman.) You would not think it right to prosecute for a quantity so small as 1-100th of a grain?—No, I should not. To me it is persecution, when the brewers are trying to do everything they possibly can.

4565. But supposing it was certain there was 1-40th, or not less than 1-40th, would you consider it right to prosecute in such a case?—I do not like doing it, but I think it ought not to be there. I do not like a prosecution for 1-40th where it is due really to the malt; and if the brewer is willing to change his malt and get pure malt, then I think, under the circumstances, a prosecution should not take place when the circumstances are inquired into.

4566. (Sir William Church.) How large a quantity of arsenic have you ever found in beer made from nothing but malt and hops?—I should put it at over 1-100th—that is to say, perhaps from 100 to 150 gallons of this beer would contain a grain of arsenic.

4567. You have not, perhaps, made any examination for that purpose? What is the largest quantity of arsenic you have estimated as occurring in beer made

Mr. C. Bell.

29 Mar. 1901.

Discrepancy
in results
of different
analysts.

Prosecution
for minute
amount of
arsenic in
beer.

But small
not tested
by water
and tested
by hops.

Arsenic in
all-malt beer.

Mr. C. Bell. purely from malt and hops?—I cannot say that, because I do not know how these beers are manufactured.

29 Mar. 1901.

4568. You have not had a beer brewed in that way given you for the estimation of the amount of arsenic?—Only this particular sample I have had myself for about seven years.

4569. It has been given in evidence before us that as much as 1-7th of a grain in a gallon has been found in beer that has been brewed from malt and hops?—I could not speak of that.

In malt.

4570. In your estimation of arsenic in malt, what is the largest quantity of arsenic you have found in any specimen of malt submitted to you?—I should say from my comparison tubes there could not have been 1-50th of a grain per lb. of malt.

4571. Do you know whether that was screened or un-screened malt?—I could not tell.

4572. (*Chairman.*) Have you any newspaper report of the case dismissed by the magistrates, though the Somerset House authorities found 1-30th of a grain per gallon?—I have not.

4573. It has been published I presume?—I should think so. I did not see it in the Manchester papers. I knew it by the chemist who had certified to the 1-40th writing to me and giving me the information.

4574. Could you tell Dr. Buchanan what newspaper he would find a report of that case in, or put in the chemist's letter?—I have not the letter now, but I will give you the chemist's name. I tore the letter up, but I can give you his name.

4575. We wish to have information as to the evidence given?—I will obtain it for you.

4576. This was all published?—I should say so; in one of the local papers—the Rochdale "Times" of March 16th, 1901.*

Tests for arsenic in beer.

4577. (*Dr. Whitelegge.*) You told us that you gave up the use of the Marsh test in the course of the recent inquiries into arsenic, and adopted another?—Yes. The Marsh test, where you just used the generating flask and allowed the gas to impinge on the cold porcelain. Now I have adopted a very different plan. It is what is called the Marsh Berzelius test.

4578. But still a modification of Marsh's test?—Yes.

4579. (*Chairman.*) Did you also use the Reinsch test?—Yes, the Marsh Berzelius and the Reinsch.

4580. Did you apply both tests on the same sample?—Yes; and when a prosecution is threatened I try it in three or four different ways.

4581. (*Dr. Whitelegge.*) What led you to discontinue the other form of Marsh's test? Was it not sensitive enough?—No, it does not show traces of arsenic at all.

4582. Is there any difficulty in detecting arsenic in beer, any complication?—I do not consider there is any if the test is worked properly.

4583. No special precautions needing to be taken?—I should not like to say that. An ordinary person could not test beer for arsenic. If you were to tell a lad to prepare some hydrogen gas he could prepare the gas, but if you were to tell him to test the beer for traces of arsenic he could not do it.

4584. You would not say it was easier to find it in beer than in water?—I should say it is easier to find it in water, decidedly so.

Beer not tested for arsenic before the epidemic.

4585. Your practice was similar to that of other analysts, I suppose, and until you gave special attention to the details of the analysis of beer for arsenic it is possible some were overlooked?—Quite so.

4586. And would you say that generally arsenic in the earlier stages of an inquiry of this kind would be overlooked in beer?—It would be.

4587. So that we must not attach too much importance to the absence of record of arsenic in the earlier stages?—No, I do not think so.

4588. Has it been your practice in former years to examine for arsenic?—I never did it before.

4589. Arsenic was not one of the substances that was recognised to be sought for?—No.

4590. Had you ever examined beer for arsenic?—Never.

4591. When you find arsenic in beer what do you re-

port under the Sale of Food and Drugs Act?—I report on the certificate, "This beer contains a mere trace of arsenic," if it is a mere trace.

4592. What would that mean as a maximum?—It might be 1-100th or 1-150th of a grain.

4593. And certifying in that sense you anticipate that the local authority will not institute any proceedings?—I do.

4594. Supposing the arsenic is present to the extent of 1-50th, what do you certify?—I should certify that "This beer contains distinct traces of arsenic, in my opinion about 1-50th of a grain." I begin then to give quantities.

4595. Is your certificate written with the idea that the authority will take it into court?—Not always.

4596. If you found 1-20th?—Yes; I should write it so that the authority could take it into court.

4597. I gather from you that where there was more than 1-10th you considered the question of prosecution ought to arise. Have you found more than 1-10th in any sample?—In the early samples there was more than 1-10th, but the rush of work was so great then, and as I was told that they were not prosecuting, it was not worth while going on with the analysis.

4598. Why do you draw the line at the 1-10th? Is there any general understanding that is the limit?—No, there is no understanding.

4599. You have to adopt some line of demarcation, and you fix it there, is that it?—No, I do not adopt any, if I find 1-20th or 1-15th. For instance, in this case I have just mentioned, where one analyst finds 1-5th and I find 1-15th, I said, "I cannot defend such a case as that."

4600. My point rather was that you make a distinction between more than 1-10th and less than 1-10th for practical purposes. Was there any particular reason for fixing on 1-10th rather than 1-15th or 1-20th?—Simply because I have my standard tubes made up to 1-10th, 1-20th, and 1-30th. If it is 1-10th of a grain of arsenic and another analyst finds 1-12th I consider that very close. I have just had one from Yorkshire where a chemist had certified to 1-12th of a grain. It was sent to another chemist, and he certified 1-25th. I have certified to 1-10th of a grain. I thought that was a case I could not defend. I found it correspond to my tenth standard.

4601. Are you satisfied with the present administration of the Sale of Food and Drugs Acts?—Yes, I think I am. I cannot see there is much to complain about it.

4602. In the case of one of the boroughs of which you are public analyst no samples at all were taken?—Not any.

4603. Is that a proper condition of things?—Not at all. I have not had any from that borough for years, although I have been the analyst for fifteen years. During the last eight or ten years I do not suppose I have had a dozen samples.

4604. Do you receive any official instructions from the Local Government Board, or any Government authority, bearing upon your appointment?—No.

4605. Do the local authorities, within your knowledge, receive any instructions as to samples to be taken?—No.

4606. So that the local authorities have no official instructions as to the number of samples, the character of the samples, or the amount to be taken for a sample?—The Local Government Board know how many samples are taken.

4607. But have the local authorities instructions as to the number of samples?—They are supposed to take one sample per 1,000 people.

4608. Where is that laid down?—I have seen it in print, but I cannot exactly say whether it is the law. That is the rule.

4609. It is a rule that is very largely not observed?—Exactly.

4610. You cannot refer me to any official instructions of any kind?—No. I may say that when I think there is anything particularly likely to be adulterated I write off to my inspectors and tell them they had better get some samples of these various things in. In the beer case, I immediately wrote to Chester, when I heard about the beer question in Manchester and Salford, that it would be wise to get some samples all over Cheshire, and they did so immediately.

4611. To what inspectors are you referring?—The county inspectors of Cheshire.

Mr. C.

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Form of certificate by P. and quantity of arsenic found in beer.

Administration of F. & D. in different districts.

* Concerning this prosecution, at Rochdale, see evidence given by Mr. William Marshall Q. 5321-8.

C. Bell. 4612. Inspectors of what?—Under the Sale of Food and Drugs Act.

4613. Are they inspectors of police?—No, special inspectors. In the county of Chester it is all under a chief inspector and four sub-inspectors, and they have to get these samples from all over the county. The number that they bring me in in a year is about 1,000.

4614. Do you instruct them?—No, I do not, except on special occasions when I knew that there was some adulterated thing in the market, and then I should say, "You had better get some of that."

4615. Do you tell them how much to get?—Yes.

4616. You told us in the case of beer that when you found notable quantities of arsenic you gave instructions which led to the stoppage of the sale?—I did.

4617. To whom did you give those instructions?—To the inspector that sent me the sample.

4618. That would be in the county of Cheshire?—Yes.

4619. To whom in the case of the other authorities for whom you act?—In regard to Stalybridge I write to the chief constable. In regard to Glossop I write to the inspector of weights and measures. In regard to Birkenhead there is a chief inspector under the Sale of Food and Drugs Act, a chief sanitary inspector I think he is called. And then the Salford inspector comes to me two or three times a week so that I should verbally tell him what I wanted.

4620. In no case does the instruction go through the medical officer of health?—No.

4621. Not even in Salford?—No.

4622. This year you say no arsenic was found in beer in Birkenhead?—No.

4623. With reference to the last part of your evidence, you think that the proceedings ought not to be taken in case the amount of arsenic is small, say, 1-10th of a grain per gallon, and the brewer is willing to change his malt?—I think so.

4624. Would you suggest that the brewer should remain satisfied with 1-100th of a grain per gallon until such time as the analyst observed this for him, and then he should express his willingness to change his malt? Is there no antecedent precaution the brewer ought to have taken? We have had brewers before us who have asked for and received guarantees that all malt supplied

to them is free from arsenic. If the brewer is producing a beer which contains 1-100th of a grain per gallon, would it not be incumbent upon him to show not only that he was intending to take, but had been taking, due precautions in the way of guarantees and certificates?—When he is informed that his beer contains 1-100th of a grain of arsenic per gallon, he should be informed that his malt must contain arsenic.

4625. Is not that rather late in the day? Ought he not to have found that out for himself before? Do not you think it is incumbent on the brewer to take all possible precautions?—Yes.

4626. To get this malt as free from arsenic as possible?—Yes; and I believe the majority of brewers do.

4627. But I understand you to put it rather that if the brewer was willing to change his malt it was not necessary to attribute any blame to him?—In this way: I put it that if his beer contains this minute quantity of arsenic he should be informed about it and told that he must change his malt. I do not think it is necessary to prosecute for 1-100th of a grain.

4628. But do not you think the brewer is to blame if he has not taken measures to secure malt as free from arsenic as practicable before this?—Certainly he ought to have taken precautions.

4629. (Chairman.) Should not he find the arsenic, if there is any, in the malt before brewing with it?—His chemist ought to.

4630. It would be an easier test to find arsenic in the malt than the amount that could be possibly produced in the beer?—Yes.

4631. Would it be a difficult test for brewers to undertake in their own works?—Brewers could not do it. They must have a proper qualified chemist to do it.

4632. But large brewers do have chemists?—Yes.

4633. And analytical laboratories?—Yes.

4634. And smaller brewers can send out to a trustworthy chemist?—Yes.

4635. Would it be very embarrassing to the brewer that he should himself get direct authority that the malt he is using is free from arsenic?—It would be no trouble at all.

4636. Would it be much expense?—No; certainly not.

Mr. HERBERT N. MORRIS, called; and Examined.

4637. You are a chemical manufacturer at West Gorton?—Yes.

4638. And a Fellow of the British and German Chemical Societies?—Yes.

4639. You manufacture sulphuric acid from brimstone?—Yes; for two years myself, and for many years it has been manufactured at the works that I now own.

4640. The brimstone sulphuric acid which you now manufacture has been made at the same works continuously for over 30 years?—That is so.

4641. How much per week do you make?—Over 50 tons per week.

4642. A large proportion of your sulphuric acid is used by mineral water manufacturers?—Yes.

4643. Do you make any speciality of this acid for use in the manufacture of food-stuffs and beverages?—Yes.

4644. Are there other manufacturers of brimstone vitriol in Manchester?—Yes, two other manufacturers.

4645-6. Do you consider that such sulphuric acid made by a good manufacturer and certified pure would be pure enough to be used for food-stuffs?—I do.

4647. Can you give the percentage of the total acid manufactured in this country which is now made from brimstone?—Only a small percentage is made from brimstone now in this country.

4648. Do you know how much percentage?—Probably not more than 5 per cent.

4649. What do you mean by brimstone?—I mean Sicilian brimstone and brimstone that has been recovered, and which contains from 98 to 100 per cent. of pure sulphur.

4650. So that sulphur recovered from chemical pro-

cesses you put in the same category with Sicilian sulphur?—I do.

4651. Which do you trust most, the Sicilian brimstone or brimstone recovered from chemical processes?—I consider a brimstone which is dissolved out of oxide by means of carbon di-sulphide, which I have tried and which I find to be quite free from arsenic, is the safest source of acid.

4652. Safer even than Sicilian brimstone?—Yes.

4653. Have you found arsenic in any specimens of Sicilian brimstone?—I have found minute traces.

4654. What do you mean by spent oxide?—I mean by that the oxide from gas purification.

4655. Not from any other source?—No.

4656. And your recovered brimstone is entirely from gas purification?—Yes. I have some of it here. It is crystallised out in fine crystals from carbon di-sulphide. As this is a product that is not largely used and that has only recently been introduced into the market, I have brought this sample to show you the nature of this brimstone.

4657. This is very unlike in appearance Sicilian sulphur?—Yes.

4658. This is greenish, and Sicilian sulphur is yellow?—That is also yellowish.

4659. Could you distinguish by eye immediately between sulphur from spent oxide and Sicilian sulphur?—I could.

4660. By the colour?—By the colour and the small crystallised nature. This is obtained in small crystals, while the Sicilian brimstone occurs in lumps, and not in crystals at all.

4661. If you break those lumps, and examine them by a lens or microscope, are they crystallised?—Yes.

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Difficulty in
uniformly
de-arsenicat-
ing pyrites
acid.

Acid made
from pyrites
in Germany.

4662. Do you never get this in lumps from the spent oxide?—No.

4663. (Sir William Church.) It is like this when you recover it from the spent oxide, by the sulphide of carbon process, but if it is recovered in other ways you get it in larger masses?—Yes.

4664. Very much like Sicilian sulphur?—Yes.

4665. (Chairman.) Why is it that so small a percentage of the total acid made in this country is made from brimstone?—One reason is that the quantity of arsenic and iron that is contained in the acid made from pyrites and oxide, which are the chief sources of the acid in this country now, has not been hitherto considered harmful or deleterious.

4666. Is it now considered harmful or deleterious?—Yes.

4667. Essentially so?—Essentially so.

4668. Cannot it be purified to deprive it of harmful qualities?—Yes.

4669. Is that a very expensive process?—It is not necessarily a very expensive process, but it needs very great care and supervision, and as it is carried on at week ends and nights, the manufacture of sulphuric acid being a continuous process which cannot be stopped, it makes it additionally difficult to completely control the process.

4670. The purification of the acid takes place after the regular manufacture has been completed?—That is so.

4671. So that the whole of the sulphuric acid which has passed through the process will need to pass through a second process to purify it?—That is so.

4672. Does that add much to the cost per ton?—Not very much; a few shillings per ton.

4673. A few shillings on how much money?—On £2.

4674. It might add 5 per cent. to the cost?—Yes.

4675. You make a speciality of acid for food-stuffs and beverages?—Yes.

4676. You do not yourself make it by the pyrites process?—I do not. I have made sulphuric acid for eight or ten years from pyrites, both Welsh, French, and Spanish, and also from oxide, and I now make it from brimstone only, because I have come to the conclusion that that is the only safe method to use for making acid to be used for food-stuffs.

4677. You consider that, with the most careful purification practicable, acid made from pyrites is not safe?—It has always an element of danger in it, inasmuch as workmen can mix one bottle with another in the works where two qualities are made, and carelessness of workmen in the purification process cannot be always checked. It can sometimes very largely, with careful supervision, but I consider it to always contain an element of danger.

4678. The pyrites process is decidedly cheaper than the brimstone?—That is so.

4679. And by adding sufficient precautions for safety, which would necessarily cost money, could you for the same money produce perfectly safe sulphuric acid from pyrites?—I should adopt either that method or the oxide method if I thought that it would not be risky, because it would be cheaper for me to manufacture in that way than to use a more expensive article, which brimstone is from whatever source it is obtained. It is always more expensive than pyrites and oxide.

4680. It would be cheaper for you to manufacture from pyrites and purify with great care than to make it as you do?—It would.

4681. But you consider that, with all the care, you could not make it so safe?—I think it is safer by using the pure ingredients to start with.

4682. Do you know the difference between the apparatus, and the dimensions of the apparatus, used in Germany for making acid from pyrites and the processes in England?—I have been through some of the largest works both in this country, in Germany, and in Switzerland, and I am thoroughly acquainted, I think, with all the well-known processes used in connection with the manufacture of sulphuric acid.

4683. The German process differs from the English in making pyrites acid, I believe?—There is one process that has recently been patented by the Badische Company in Germany, which, so far as I know, is

not used in this country, which is essentially different from our methods of manufacture.

4684. Is it the case that a large proportion, or perhaps the whole, of the sulphuric acid made in Germany hitherto has been made from pyrites?—That is so, and by the same process as it is made in this country.

4685. Do you know of any making of sulphuric acid in Germany from Sicilian sulphur?—I cannot speak about that.

4686. But certainly the greater part of sulphuric acid made in Germany is made from pyrites?—That is so.

4687. Do you know if that is purified from arsenic after the manufacture from the pyrites?—It is.

4688. In Germany it is habitually purified?—Yes.

4689. (Dr. Whitelegge.) Invariably purified?—No, not invariably.

4690. (Chairman.) Then some of the German sulphuric acid contains arsenic?—Decidedly, a very large quantity of it. I cannot speak of the percentage of the acid that is sold in Germany which contains arsenic, but certainly a very large proportion of it contains arsenic, and arsenic in large quantities.

4691. It has been stated before us that the German pyrites process differs from the habitual English pyrites process in the dimensions of the furnace and flues; it has been said that in the German pyrites process the fumes are led through a longer flue, and that arsenic is deposited on the flue before it comes to the condensing chamber, whereas in the English pyrites process the fumes are brought more directly to the condensing chamber, and contain therefore more fumes of arsenic?—That is not so. There is one process which is used in Germany which differs essentially from our English processes, and by that process the gases from pyrites ovens are passed through a very elaborate system of purification before entering into what is called a contact chamber of platinum, which is used for making the acid.

4692. To condense the fumes?—Yes, in the platinum vessel, and if there are any impurities in the gas used in this process they would act on the platinum. That process is a recent one, and can only be erected on a very large scale such as is used in Germany. I believe it is not used in this country as yet.

4693. Is that under the Badische patent?—Yes.

4694. Does that give very pure sulphuric acid?—Yes.

4695. Quite free from arsenic?—I have not examined any acid made by this process. So far as I know it is only made successfully at that one factory on the Continent.

4696. In the habitual German manufacture hitherto is there any difference, in respect to the length of the flue, from the English process?—Nothing notable, with the exception of that process I have named.

4697. That is a new process under the new patent, but the ordinary process is substantially the same as the English?—Yes.

4698. And the gases are brought into the leaden chambers where the sulphurous acid is converted into sulphuric acid. Is the temperature of the fumes coming into the leaden chambers practically the same in the German process and the English process?—It is.

4699. Consumers of sulphuric acid, who are very often not chemists, have not been aware of any difference in quality between pure and impure acids?—That is so.

4700. And have been misled by advertisers offering acid made from sulphur?—That is so.

4701. Is there any evidence, except in Nicholson's Trade case, that pyrites acid is sold as sulphuric acid, whether meaning purified or not purified?—I speak from memory now, sulphur but I am under the impression that I have seen another acid advertisement offering acid made from sulphur which has not been made from sulphur, but from pyrites. I was under the impression myself that the firm that advertised did actually make at least a certain proportion of their acid from sulphur.

4702. You know of just that other case beside the Nicholson's case?—Yes; one other besides Nicholson's.

4703. You told us you used Sicilian brimstone and Arsenic brimstone extracted from oxide by means of carbon disulphide; and the latter you find the most reliable as regards freedom from arsenic?—I do.

4704. Did you never find more than a slight trace of arsenic in Sicilian brimstone?—No.

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oxide.

H. N. 4705. Have you found any trace of arsenic in acid made from Sicilian brimstone?—I have, a trace. I have Marsh tubes here showing the relative proportion of arsenic in acid made from the different sources. For a considerable time I used nothing but Sicilian brimstone, and I have the test showing acid made from Sicilian brimstone, which contains a faint trace of arsenic. (*Specimens shown to Commission.*) You can only see a slight film. All these tests are made by taking 25 cc. of the acid and diluting to 250 cc. of water, pouring all these contents into a flask containing 30 grams of zinc, and working for one hour, which is the time required to expel practically all the hydrogen. This method I have found to work very satisfactorily, giving a uniform small flame of $\frac{1}{16}$ in. to $\frac{1}{8}$ in. long.

4706. That is the Marsh test?—Yes. After having the chambers full of acid made from this recovered sulphur I have mentioned, I had a test made in the same way, and that is the result. In that case there is no film. (*Specimen shown to Commission.*) I have also had this analysed by many analysts, and most of them have pronounced it perfectly free, and one or two have said that they have found a slight trace.

4707. A slight trace in the acid made from the Sicilian brimstone?—No, from the recovered brimstone. Most of the analysts who have analysed this for me, in addition to my own chemist's test, have pronounced it absolutely free, but one or two have said that they find minute traces.

4708. If you were trying the same test on a much larger quantity of acid, could you get a larger result?—Yes; that would show a little plainer.

4709. Can you give any estimate of what the quantity shown here would be per litre of the acid?—No; it is so small that I do not think any estimate could be made, whatever quantity is used. I have comparisons with exactly the same test made with other kinds of sulphuric acid. (*Specimens shown.*) These are from two makes of spent oxide from gas works.

4710. That is sulphur from spent oxide?—No, the spent oxide itself. That is used very largely in this country for making sulphuric acid now.

4711. Do they call that brimstone acid?—No.

4712. B.O.V. means brown oil of vitriol?—Yes.

4713. When you hear workmen talking of stone acid, is that brimstone acid?—No. Oxide acid is considered to be free from arsenic, and is stated by some people to be free from arsenic. But I find it contains a considerable quantity. These are the tests which I have made.

4714. From 25cc. of acid?—Yes. When you compare those specimens with pyrites acid you will see there is a marked difference. These contain comparatively only traces of arsenic.

4715. You use sulphur from spent oxide?—The sulphur is extracted and precipitated.

4716. In the manufacture of sulphuric acid spent oxide is burnt and its fumes used?—The spent oxide itself is burnt in the same way as pyrites, in ovens similar to pyrites ovens.

4717. Spent oxide may give some arsenic to sulphuric acid, but pyrites still more?—Yes. This is the ordinary pyrites acid test. (*Specimen shown.*) Those are crystals of arsenious acid.

4718. The silver-coating is what?—Metallic arsenic.

4719. And the black is what?—Metallic arsenic also. That is the ordinary pyrites acid of commerce without having been purified.

4720. Then the manufacture of acid shown here from oxide and here from pyrites is by the same process?—Yes.

4721. The cheapest acid is made from the pyrites?—Yes.

4722. And what would be the expense of making acid from oxide?—It is dearer than pyrites acid, but not so costly as brimstone acid.

4723. Is any of this oxide acid sold by the manufacturers as being brimstone acid?—Not that I am aware of.

in acid. 4724. How much per litre would give such effect as this specimen from pyrites acid which you show?—The actual percentage of arsenious acid is 1.6 per cent. by weight—1.6 grammes per 100 grammes of the acid.

4725. Can you tell how much there might be in this other specimen of pyrites acid?—I have not estimated the quantity. It is small.

4726. Considerably less than 1 per cent.?—Considerably less—probably less than 1-10th per cent. Here is a specimen 1 per cent. of pyrites acid in pure acid—that is to say, this is pure acid mixed with 1 per cent. of pyrites acid. You have there an example of the adulteration that 1 per cent. of this pyrites acid makes.

4727. (*Dr. Whitelegge.*) What form of pyrites acid was that?—Would it be tower acid?—Yes.

4728. (*Chairman.*) When there is so great a quantity as 1.6 per cent. is the arsenious acid dissolved in the sulphuric acid?—Yes.

4729. How much arsenious acid could you dissolve in sulphuric acid?—I have never tried. I do not know what a saturated solution is.

4730. But it is freely soluble?—Yes.

4731. It is not known how much?—I think not. I certainly do not know.

4732. 1.6 sounds enormous. Do you think it would dissolve 10 per cent.?—I think not.

4732*. Is it possible that some arsenious acid would be deposited in time in that acid if it were to stand?—If this acid stood for some time it is possible the arsenious acid would crystallise out slightly. It seems to have that property.

4733. B.O.V. contains other impurities besides arsenic?—Yes.

4734. Does the arsenic combine with some of the other impurities or dissolve in the sulphuric acid independent of the other impurities?—I think it is dissolved independently of the other impurities.

4735. (*Sir William Church.*) Are you acquainted in the trade with brown oil of vitriol which contains a deposit of arsenious acid?—I have never, until this has been mentioned in the inquests on the beer poisoning cases known arsenious acid to crystallise out from sulphuric acid in commerce. I have known a deposit of sulphate of iron out of the acid.

4736. (*Chairman.*) If you leave a jar of brown oil of vitriol for weeks or months does the glass become incrustated with something deposited from the acid?—Yes, it does.

4737. If you pour it into another glass will the acid be cleared?—Slightly cleared.

4738. Would filtering make any difference to the brown oil of vitriol?—I think not.

4739. It would go through, colour, arsenic, and all?—Yes, I think so.

4740. Is arsenious acid nearly as soluble in water as in sulphuric acid?—It is not.

4741. Take the sulphuric acid containing 1.6 per cent. of arsenic. If you mix a very large quantity of water with it would that deposit the arsenic?—I should think so. I have not tried it.

4742. It might still be dissolved in the highly dilute sulphuric acid or might be deposited?—Yes, and it might be present as arsenic acid, which is a liquid.

4743. Is there any arsenic acid in the sulphuric acid?—I think it is present as arsenious acid.

4744. It could not be arsenic acid without more oxygen?—No, it could not. I have here two examples of the purified pyrites acid. The first contains only a small amount, and is nearly as pure as the samples of brimstone acid, but the second one contains a fair quantity. (*Specimens shown.*) That was bought by me some time ago, and I asked for some acid specially well purified and free from arsenic, and this is what I got, containing a considerable quantity. I wrote to say it contained a considerable quantity, and I got a further lot, which you see is very much better.

4745. After your first inquiry they probably purified it further?—They took more care in purifying it.

4746. But this first specimen demonstrates the unsatisfactoriness of the de-arsenicated process?—That is so.

4747. Unless purified with extreme care?—I think so.

4748. (*Dr. Whitelegge.*) In recovering sulphur from the spent oxide by bi-sulphide of carbon, is there any danger of taking over the arsenic in the solution?—No, arsenic is not soluble in carbon bi-sulphide.

4749. (*Sir William Church.*) Would you consider that using the Sicilian sulphur would excuse you, as a manufacturer of sulphuric acid to be used in the preparation of food stuffs, from examining it after manufacture?—Certainly not; it never has done.

Mr. H. N. Morris.

29 Mar. 1901

Mr. H. N.
Morris.

29 Mar. 1901.

Arsenic in
Sicilian
brimstone.

4750. Therefore even the acid made from Sicilian sulphur would require to be examined after manufacture before it could be guaranteed pure?—That is so, if a guarantee be given. I do that. I have a special form.

4751. I am not doubting that you do that. Is it not also the case that sometimes you get a very considerable trace of arsenic in Sicilian sulphur? Pockets are come across in which there is a large quantity of arsenic?—I have never come across a pocket of arsenic in Sicilian brimstone. Such things do occur; they are facts; but even if a pocket of arsenic were present in a delivery of Sicilian brimstone that quantity when it got into the chambers would be so very much diluted, generally with at least 100 tons of sulphuric acid in the chamber process, that even in that case it would not render the acid unsafe, but would still only appear as a mere trace.

4752. (Chairman.) Is the pocket visible to the eye?—I understand that it is not larger than the fist.

4753. That pocket would contain what materials?—A large percentage of arsenic.

4754. Not all arsenic?—No.

4755. Would half the mass be arsenic?—It might be half the mass.

4756. That would be a very large quantity to be mixed up with the acid?—That is so. With 100 tons of acid it would have to pass in the form of vapour, and in that case it would be infinitesimal. I do not think it would be detected in the acid as making a marked difference.

4757. (Sir William Church.) If that is the case, what is your object in examining your acid after manufacture?—It is simply in giving guarantees to customers. I have to give guarantees, and in order to do that it is absolutely necessary to test every delivery. I have not only to do that, but for some customers I have to examine each carboy.

4758. If this is done, the only reason why acid made from pyrites would be less safe would be the possibility of the mixture of the carboys?—That is so.

4759. If you had to test your acid after you had manufactured it, and if the manufacturer from pyrites tested his acid too, the danger would be only in the mixture of carboys, carboys of impure acid getting delivered as carboys of pure acid?—That is so; but there is also another thing to consider—that a chemist, if he found a small quantity of arsenic in the purified pyrites acid, might pass it without the knowledge of his employer, and the employer might have a heavy claim against him for damages if it were found out. There is a double risk in using that process.

4760. Is there not also a risk that, not you, but other manufacturers of brimstone acid may give their guarantee without a careful analysis when they use such good materials?—I have considered the risk, and I certainly find the risk in using the purest materials that could be obtained for the manufacture of the article is the slightest.

4761. That, of course, one accepts at once. I only suggest that where a person was in the habit of using such pure materials that no contamination was found in the manufactured article, that the analysis of that manufactured article would be likely to be less carefully conducted than where it was known that certainly there was a risk of it?—Yes, there is the possibility, of course.

4762. (Chairman.) The pockets of arsenic of which you spoke are very rare?—Extremely rare; although I have used hundreds of tons of Sicilian brimstone I have never seen one of these pockets in the sulphur.

4763. It would be manifest in sulphur of the size that you use. What sized pieces do you use?—It is broken into pieces the size of one's fist.

4764. So that a large portion could not escape observation?—No.

4765. Is it a different colour from the rest of the sulphur, and a common workman shoving it in with the shovel would see it?—Yes, it would be a curiosity to him.

4766. But you have never found such?—I have never seen it. I have read of it as a scientific fact.

4767. (Mr. Cosmo Bonsor.) Do I understand that you give a guarantee with every delivery of acid you send out?—I guarantee that it is made from brimstone and that it is free from arsenic.

4768. A double guarantee?—Yes.

4769. (Chairman.) Do you make a test?—I put it on the invoices. It has to be initialised by the chemist who tests it before the invoice is sent out.

4770. The finished product?—Yes; it is possible that a dirty vessel might be used to fill it into. That is an additional precaution of testing the article before it goes out of the works.

4771. (Mr. Cosmo Bonsor.) How long have you been giving that guarantee—ever since you have been in business?—Ever since I have had these works. I have had labels like these:—"Pure Brimstone Vitriol."

4772. Have you to send the guarantee free from arsenic?—No.

4773. Not till lately?—No.

4774. Since the epidemic?—Yes; but all along these kind of labels have been put on.

4775. (Chairman.) Have you a process of rectification besides the manufacture from pure brimstone?—Yes; I have two classes of labels. Some of them have "Brown" at the bottom, which means B.O.V., and others mean R.O.V.; it means this is 98 per cent., whilst the brown is 80 per cent. of sulphuric acid, the rest being water. It has not been concentrated.

4776. Does brown indicate other impurities?—Organic matter.

4777. The rectified is purified of the organic matter?—Yes; it is distilled.

4778. There are some volatile gases in ordinary sulphuric acid. Are there any volatile matters in this brown oil of vitriol?—There are compounds of nitrogen which are expelled in the rectification, and in the rectified acid I have to give a guarantee that it is free from nitrogen compounds and from arsenic.

4779. To be used for a drying agent in chemistry it must be freed from these volatile products?—Yes.

4780. (Chairman.) What is the specific gravity of the B.O.V.?—Spec. grav. 1.75 or 80 per cent., and the rest water.

4781. Do you have 100 per cent. of acid?—No; it is not possible to get sulphuric acid 100 per cent. You cannot get more than 98 per cent.

4782. As a drying agent, what percentage of sulphuric acid would there be?—98 per cent.

4783. (Dr. Whitelegge.) Which acid do you supply for the manufacture of food substances?—The R.O.V., and that which is free from lead. The R.O.V. is not free from lead.

4784. (Chairman.) How much more does this acid cost than the first product?—Twice as much as the B.O.V. The purification of the lead and the rectification make it twice the price.

4785. On the label you mention arsenic?—Yes.

4786. You did not mention arsenic on the labels previous to this scare?—No; I did not mention it in the guarantees.

4787. A label satisfies which contains the word arsenic, but your corresponding label did not contain the word arsenic a year ago?—No; it was only guaranteed made from brimstone.

4788. (Dr. Whitelegge.) You did not mention lead before the epidemic, did you?—No.

4789. (Chairman.) It has been always a speciality of your works to make the acid free from arsenic?—That is so.

4790. Before this epidemic occurred?—Yes.

4791. You considered arsenic before the epidemic occurred?—Yes.

4792. Was it regularly tested for that impurity before the epidemic?—Yes.

4793. Even before the epidemic you tested all the sulphuric acid that you gave out as pure for arsenic?—Yes.

4794. Years ago?—Yes.

4795. (Sir William Church.) And lead?—No.

4796. But surely the danger of lead was very much greater than the danger of arsenic?—But in the processes lead is generally precipitated, and the clear liquor drawn off. I believe in sugar making that lead does not matter as an impurity, because in the process used the lead is deposited and the clear liquor is drawn off, and contains no lead. Some people require it also.

Guarantees
of brimstone
acid as
arsenic-free.

Mr. E.
Morris.
29 Mar

H. N. free from lead, and to those who ask for it free from lead I send them the quality I have shown you.

4797. (Chairman.) But you would not approve of it being used for food-stuffs unless purified from lead?—I do not guarantee it. Where people have written asking me to guarantee the acid free from all impurities, I always replied before sending any that my common acid is free from arsenic and nitrogen compounds, but not from lead. It contains a trace of lead, and that if they wish it freed from lead they must have the other quality, and I mention the price.

4798. The lead will be in the form of sulphate of lead dissolved in sulphuric acid?—Yes.

4799. The trade journals for some years have warned the makers of beverages against the use of impure sulphuric acid?—Yes.

4800. You have extracts from the "Mineral Water Trade Journal," September 17th, 1895?—Yes. In 1895 there was an article in the "Mineral Water Trade Journal" on the "Purity of Mineral Waters," which I can read: "The purity of Mineral Waters," they say, "The attention which the mineral water trade is exciting in the London dailies and in all parts of the country, consequent on the agitation against the interference of the military in competition with civilian traders, leads us to the consideration of the important question of the purity of the beverages so popular with our countrymen. The purest mineral waters are produced by using vitriol made from brimstone, and no other kind should be used. The advantage to be gained by this is, that it is absolutely free from arsenic, whereas the common quality of vitriol is made from pyrites which contain a large amount of arsenic, and, consequently, should not be used in the manufacture of a table drink." That was in 1895, and in 1900, on August 17th, in a leading article in the same journal, it said: "The question of arsenic, as an impurity in vitriol, is of the utmost importance, and it is needless to tell our readers that cases have frequently occurred of arsenic poisoning through drinking mineral waters containing even traces only of that injurious substance, sometimes with fatal results. It is almost impossible to completely purify common vitriol made from pyrites, from arsenic, and we should advise all mineral water manufacturers to give this matter their serious consideration."

4801. Do you yourself know what cases are alluded to?—I do not.

4802. (Mr. Cosmo Bonser.) Did you write that article?—I did not. This is a leader.

4803. (Sir William Church.) A leader from a trade journal?—Yes, the "Mineral Water Trade Journal."

4804. Have you any knowledge of whether that is true, that cases frequently occur of arsenical poisoning from drinking mineral waters containing only traces of that injurious substance?—I have read myself in the paper of a case in France two or three years ago. I do not remember the particulars now. The mineral waters had been the cause of arsenical poisoning in that case. I do not remember the paper now, but it was pointed out to me at the time.

4805. Have any cases ever been recognised in this country?—I do not know; this was in France.

4806. There have been cases of disease recognised as occurring from mineral waters in this country?—I cannot say with certainty about that.

4807. Are not you aware there have been many cases in which lead poisoning has arisen from mineral waters?—Yes.

4808. I have never heard of a case of arsenical poisoning; I will not say they have not been recorded; but there have been cases of lead poisoning?—Yes.

4809. (Dr. Whitelegge.) How does the arsenic get into the mineral waters from the sulphuric acid?—I do not know exactly the processes that the mineral water manufacturers adopt, whether any of them use the sulphuric acid direct; that is, bring it in contact with the beverage that is drunk. It is possible they do.

4810. If they only use it for generating the carbonic acid gas?—Then, unless they use a metallic vessel for generating that gas, or some metal gets in, they are not likely to get the arsenic over with the carbonised gas. I know that sulphuric acid is used by workpeople as a drink in summer. I have known workpeople for the last ten years every summer to put a few drops of sulphuric acid in a glass of water and drink

that in preference to plain water. It gives the water just a sour taste.

4811. You have examined a good many samples of acid made from spent oxide?—I have.

4812. Has your experience in general been as unfavourable as in the particular instances you have shown us? Would you say that spent oxide generally contained notable quantities of arsenic?—Yes.

4813. And that acid made from spent oxide is usually largely charged with arsenic?—That is to say, largely charged? I do not consider these specimens I have shown you to be large quantities.

4814. But do you think them fair samples?—I think one of them is above the average as regards purity, whilst the other one is rather below the average. One of them is bad, and I have not found many as bad as that. One of them, however, is better than the average.

4815. (Chairman.) Where does the arsenic in the oxide acid come from?—It must come over from the bog ore which is used for purifying the gas, and which absorbs the sulphuretted hydrogen, or from the pyrites in the coal, which is carbonised, and must pass, in that case, along with the sulphuretted hydrogen as arseniuretted hydrogen, and be absorbed in the gas purifiers.

4816. What do you mean by bog ore?—Bog iron ore; a hydrated oxide of iron which is used for absorbing the sulphuretted hydrogen from coal gas.

4817. And is it liable to contain arsenic?—I think so. That is one reason I give for the acid containing arsenic.

4818. We should like to have on record the prices of oil of vitriol?—My selling prices for brimstone vitriol at my works, last year, were: B.O.V., 35s. to 40s. per ton; R.O.V., £3 15s. to £4 per ton. The selling prices of pyrites acid were: B.O.V., 25s. to 30s. per ton; R.O.V., £2 15s. to £3 5s. per ton. During the last few years I have bought for an aniline dye manufacturer large quantities of pyrites, B.O.V. at 28s. 6d. per ton, delivered into consumer's works, half a day's carting distance, and so-called non-arsenical acid at 32s. per ton, delivered nearly a day's journey.

4819. You have tried 100 samples and consider that brimstone vitriol made from either of the sources you have mentioned is absolutely safe for use in the preparation of articles for human consumption so far as arsenic is concerned?—That is so.

4820. Selenium is said to occur in pockets in Sicilian brimstone. Have you met with selenium?—Selenium is a substance about which so little is known, and the distinctions between selenium and arsenic are so difficult to make out, that I am not able to say anything about that.

4821. Would it not show in the colour in the Marsh test, or in the Reinsch test?—I have bought chemically pure selenium and dissolved it in sulphuric acid, and applied many tests for arsenic to that sulphuric acid, and I have found that it gave all the tests almost exactly the same as arsenic. But I am not able to say whether that selenium was pure or whether it contained arsenic, which is, in my opinion, a very liable contamination.

4822. (Dr. Whitelegge.) Was your sulphuric acid free from arsenic?—Yes, it was quite free.

4823. Was the selenium deposited in the tube as a brick-red colour?—No, it was brown, and I got very large deposits.

4824. (Chairman.) Not more red-looking than the arsenic?—Not much.

4825. Do you consider then that selenium would show practically the same as arsenic in these tests?—I am not able to speak with certainty about selenium, because so little is known about it. I have tried to get as much information as I could about it, and about methods of testing selenium and selenium products, but there is so little published, and so little has been done with it, that I cannot say anything definite.

4826. (Sir William Church.) You had no experience of it before this poisoning scare?—I worked with it before this poisoning scare.

4827. With what object?—I started a research on the properties of selenium and selenium compounds, but I had not time to complete it.

4828. An independent research?—Yes; it was because so little was known of selenium and so little was published in the literature that I was undertaking some research work.

Mr. H. N. Morris.

29 Mar. 1894

Arsenic in spent oxide acid.

Mr. H. N.
Morris.
29 Mar. 1931.

Winstan-
acid not de-
arsenicated.

4829. Those were purely scientific researches, not in any way connected with your occupations as a manufacturer and chemist?—They were not.

4830. (Dr. Whitelegge.) If you examined samples of your sulphuric acid for arsenic and found a trace of arsenic in it, what would you do: would you purify it?—No, I should send it to bleachers or dyers, who also buy from me.

4831. (Sir William Church.) Therefore, there is a chance of your carboys getting mixed the same as in an ordinary manufactory?—No, the quantity of impurity is so minute in any of these tests that it is only a question one might say of degrees of infinity.

4832. Clearly if you do put any aside as not being pure acid there is the same risk of carboys getting mixed in your works as in others? Perhaps not so great a risk?—As a matter of fact, I have never put any aside for impurity through arsenic, but only through nitrogen compounds and lead, and these are not of consequence in the manufacture of glucose.

4833. (Mr. Cosmo Bonsor.) Did you ever supply Bostock's?—No.

4834. Did you call upon them?—I have quoted for them.

4835. Over the price?—A little over.

4836. Your price was a little higher?—Yes, slightly; I believe about two shillings per ton.

4837. Do you supply sugar refiners at all?—I supply

people who use it for the same process as sugar refiners, or manufacturers of invert sugar.

4838. Is this acid used at all in the process of making flaked malt, do you know?—Not to my knowledge.

4839. It is purely for the conversion of sago and rice into glucose?—Yes, into glucose and vinegar.

4840. Distillers used it considerably, too, do not they? Do not they convert their maize and other grains in that way?—I believe so.

4841. Do you supply any of them?—No, not distillers.

4842. (Chairman.) You have tendered to Bostock for sulphuric acid?—Yes, but only since their name appeared in the paper.

4843. You never tendered to them before?—No. I tendered, I think, in November last, before much inquiry was made into the matter.

4844. (Mr. Cosmo Bonsor.) Might I ask you how your trade is worked; is it worked by travellers or circulars?—By travellers.

4845. I presume the travellers know pretty well each chemist's customers and do not call very much upon the other men's customers?—Yes.

4846. It is more or less of a ring, I presume?—That is so. I may add that my travellers have always made a point of warning these people against the use of pyrites acid on account of the danger of arsenic.

4847. Did your travellers go to Bostock's and tell them that?—No.

Professor SHERIDAN DELÉPINE, Professor of Pathology, Owens College, Manchester, called; and Examined.

Prof.
S. Delépine.

4848. (Chairman.) You are Professor of Pathology and Director of the Pathological Laboratories at the Owens College, Manchester?—I am.

4849. You are, I believe, frequently consulted by sanitary authorities in Lancashire, and you have been doing, with the assistance of Dr. Coutts and others, a considerable amount of research work upon arsenic in beer, at the request of the Town Council of Salford?—Yes.

Peripheral
neuritis
and higher
alcohols.

4850. We have heard from Dr. Tattersall that on the 16th of November he consulted you in connection with the outbreak of peripheral neuritis in Salford, informing you that beer had fallen under suspicion. In the first instance, I understand, as you were told that samples of the suspected beer had been analysed and found to contain no poisonous substance, you turned your attention to the possible presence of certain higher alcohols. Can you tell us, in order to dispose of this part of the question, what ground you have for thinking that peripheral neuritis might be caused by higher alcohols?—Yes; but, as a matter of fact, I still maintained my belief that metallic poison was the cause of the outbreak; but, taking in account the results of the analyses which had been given as an indication that this theory might prove to be correct, considered the higher alcohol theory. This theory appeared improbable, for only a very small amount of these alcohols could be generated during the ordinary fermentation of wort, and there was not the slightest reason to believe that a number of brewers had adulterated their beer with raw spirits, which would, of course, introduce the higher alcohols, there was, however, a remote possibility of some new method of fermentation having been adopted, or of some unsuspected change in the yeast, that might give rise to a greater proportion of higher alcohols than normal. Raymann and Kruis have shown that certain yeasts grown under abnormal conditions may form amylic alcohol, acetaldehyde, and furfural (Joergensen, *Les Micro-organismes de la Fermentation*. Transl. by P. Freund. Paris, 1899, p. 182). Some researches conducted under my direction in 1894-95 by Dr. W. J. Kerr had indicated that the administration of various alcohols was usually followed, in rats, by symptoms resembling those of beginning alcoholic paralysis. Such effects were produced by doses smaller in the case of amylic alcohol than in that of the lower alcohols. On the supposition that these alcohols have the same effect on man as they have on rats, one may calculate, on the basis of the doses given to rats of known weight, the quantities which a man weighing 140 lbs. would require to be influenced in the

same way. The results of such calculations may be tabulated as follows:—

I.—ADMINISTRATION BY THE RECTUM.

—	Experi- ment.	Duration of Experi- ment.	No. of Doses.	Average Dose.*	Daily Average.*
Methyl Alcohol	XII.	45 days.	35	16 oz.	12½ oz.
	XIII.	60 "	47	17 "	13½ "
	XIV.	75 "	60	18 "	13 "
Ethyl Alcohol	III.	70 "	55	13½ "	10½ "
	IV.	70 "	55	11 "	8½ "
	V.	60 "	48	17 "	13½ "
Amylic Alcohol	XVI.	20 "	15	3½ "	2½ "
	XVII.	32 "	24	5½ "	3 "
	XVIII.	25 "	18	5½ "	3 "

II.—ADMINISTRATION BY THE MOUTH.

—	Experi- ment.	Duration of Experi- ment.	No. of Doses.	Average Dose.	Daily Average.
Methyl Alcohol	XXIV.	30 days.	20	18 oz.	12½ oz.
Ethyl Alcohol	XXIII.	52 "	42	16½ "	13 "
Amylic Alcohol	XXV.	60 "	47	7 "	5¼ "

4851. What does the average dose mean?—The amount which was given at one time, and the daily average is an equalisation of all these doses, admitting that they were taken, equal daily doses.

4852. Calculated from the proportion, as the weight of the rat is to 140 lbs., so is the dose you gave?—Yes, the table gives the amount which a man would have to take to absorb the same amount of alcohol that a rat was taking. The peculiarity of the paralytic symptoms

* The doses represent the amount of absolute alcohol given in each case. The methyl and ethyl alcohols were diluted with four times their weight of water. The amylic with three times its weight of olive oil.

Mr. H.
Morris.
29 Mar.

Prof.
S. Delépine.

ref. produced in all these cases was that they followed rapidly after the administration of large doses of alcohol and gradually disappeared afterwards. The outbreak investigation showed symptoms very different from those which I observed in those rats.

4853. Would the corresponding amounts of alcohol necessary to produce similar poisoning in man be very large indeed?—Yes, the experimental doses were very large, and the alcoholic strength of the solution was much higher than that of beer. The rats were never kept alive for more than three months, and it is possible that smaller doses frequently repeated and given for a greater length of time might have given rise to more lasting paralysis. The symptoms indicated central rather than peripheral changes. That is to say, the hind limbs were paralysed first, then gradually the fore limbs; then the hind limbs would recover, and afterwards the fore limbs. There was a perfect equality of the symptoms on both sides of the body. The amount of alcohol necessary to produce the symptoms was greater in the case of methyl alcohol than in the case of ethyl alcohol; amyl alcohol acted in much smaller doses than either of the above. All these quantities were distinctly larger (and in the case of amyl alcohol very much larger) than the amount that might be expected to be present in a gallon of light beer. I am not speaking now of strong beer containing 10 per cent. of alcohol or more.

4854. It seems unlikely that there would be found in any community a sufficiently large number of persons capable of drinking an amount of beer large enough to account for the widespread outbreak of disease, and that the beer also should contain such a large quantity of a form of alcohol which is quite foreign to ordinary beer?—Yes, and as a matter of fact, we know now that many moderate drinkers did not escape. The alcoholic theory, though not unreasonable, was therefore insufficient.

4855. (Dr. Whitelegge.) What you observed was a central rather than a peripheral change, I understand?—Yes.

4856. So that it would be hardly peripheral neuritis?—It is very difficult to recognise in the early stages the share taken by nerve centres.

4857. But you regard it, do you not, as really central and not peripheral?—Yes. It may be that arsenical paralysis is also partly central. The nerves as well as the central nervous system are affected in the later stages, but it is difficult to say exactly how much the one precedes the other. But the symptoms were certainly very different.

4858. (Chairman.) You conclude that the alcoholic theory, though not unreasonable, was insufficient?—Quite.

4859. I understand that you were also considering the possibility of other causes of the illness, such as toxin produced by bad yeast, when you learned of the discovery of arsenic by Dr. Reynolds?—Yes. I was making preparations for an investigation of all the causes which appeared possible, metallic poisons being the most likely in my mind; but I took steps to investigate any other possible causes in case the more likely cause failed. But within four days of my consultation with Dr. Tattersall I heard that Dr. Reynolds had found that the incriminated beer contained arsenic. The importance of the discovery of arsenic by Dr. Reynolds was evident, and I at once offered Professor Dixon Mann, who had given me the information, one of my samples to verify the fact; this he did on the 21st of November, when he entirely confirmed Dr. Reynolds' discovery. We had no difficulty in proving the presence of a large quantity of arsenic in the beer (see Table I, Samples A, B, and C, Appendix No. 12), and a more complete knowledge of the skin symptoms to which attention had not previously been directed, made it clear that a cause, if not the sole cause, of the outbreak had been found.

4860. This table you referred to is contained in the pamphlet which I hold in my hand?—Yes. It is the same as Table I. to the special report to the Salford Town Council: "On an Epidemic of Arsenical Poisoning from Beer, 1900," by Dr. Tattersall, and a "Report of Chemical Investigation" by myself.

4861. May we take these tables as not requiring correction according to your present knowledge?—I have not noticed yet any error.

4876.

4862. We will take these tables, then, as given in evidence?—There are three main columns. The first column gives the parts in ten millions so as to make all the analyses comparable for practical purposes; the number of grains per gallon is given in the second column. One and a-half grains per gallon was the maximum found.

4863. What does the word "private" mean?—That this sample of beer had been sent to me by another medical officer of health and was not one of Dr. Tattersall's samples. It was from Hyde in Cheshire.

4864. Is it known from what brewery it came?—It is known, but I am not at liberty to mention it because I got it privately. I know that Bostock's sugar was used there.

4865. I see you mention Munich and Vienna beers with no traces of arsenic?—I could not find any trace of arsenic in either of those beers. The first thing I did at the beginning of the inquiry was to try and find any beer free from arsenic, and I obtained beers from various parts of the country and from the Continent. The only two beers in which I found at that time no trace at all of arsenic were one sample of dark Munich beer, which I have used since as a standard and for the dilution of other substances, and a light lager or Vienna beer.

4866. Did you find in any other beer you tested beer or a few absolutely free from arsenic?—A few beers obtained afterwards were occasionally free.

4867. What about the one marked N.?—N. contained apparently no arsenic, but I was not certain it was entirely free. When tested by Reinsch's method it did not leave the copper as clean as the Munich beer, but there was not enough arsenic there, if any, to allow of a sublimate being obtained.

4868. Would you say there was less than 1-100th of a grain per gallon?—I should say less than 1-500th. I would not like to give any number. I give this only as a kind of rough inference from the appearance of the copper.

4869. (Dr. Whitelegge.) Is it not the fact that other causes besides arsenic might affect the copper?—Yes; that is what makes it absolutely impossible to say whether there was or was not arsenic present in very minute traces. If there had been no possibility of any other substance giving a dark colour to the copper one would have said there was certainly a trace of arsenic.

4870. The only suggestion of arsenic is due to the discolouration of the copper, which might have been due to another cause?—Yes.

4871. (Chairman.) In the beer marked K, you found no arsenic?—I found only a trace.

4872. Was that discolouration of the copper or actual crystals?—When I put down a trace, there was actually a sublimate obtained, but so slight that it was a difficult thing to estimate the quantity.

4873. (Mr. Cosmo Bonsor.) Why did you go to Munich and Vienna?—The only reason I went to Munich was that there was an importer in Manchester from whom I could get genuine German beers easily. I tried to get beer direct from the Continent, but I found it was difficult. I went to Munich because I knew there was a strict law there prohibiting entirely the use of malt substitutes. I thought that by going to a country where the law was very strictly enforced I might probably get an idea of what beer produced under those conditions would be like.

4874. (Chairman.) When you commenced the inquiry, did you find arsenic in large quantities in your beer samples?—Yes; and we found that the poison was sufficiently abundant to make its detection easy in less than half a tumbler of certain beer. Nothing but an artificial product used in large quantity could account for such a contamination. Of the artificial products used for brewing purposes, brewing sugars are the only ones which are used in large quantities. I therefore concluded at once that the brewing sugars had most probably been the means of introducing arsenic into the beer. Glucose had been previously shown to contain at times a large amount of arsenic, derived from impure sulphuric acid.

4875. Had that been found before the outbreak of the epidemic?—I knew it had been found previously.

Prof.
S. Delpine.
29 Mar. 1901.

Arsenic in
Nicholson
acid.

by some observer, and I have found since then the exact reference to his work.

4876. Can you tell us first about the sulphuric acid?—The sulphuric acid I found not only to contain a large amount of arsenic but also to be actually supersaturated with the poison. Part of the arsenious acid had separated from the acid in the shape of a white precipitate. The nature of that precipitate was at first a matter of doubt. It was neither sulphate of lead, nor sulphate of iron or lime. I ultimately discovered that it was composed of arsenious acid or of some substance composed almost entirely of arsenious acid. I was able to obtain a precipitate having the same properties by supersaturating pure sulphuric acid with pure arsenious acid. The precipitate was also found by actual analysis to contain more than twice as much arsenic as the fluid above it. This fact was communicated to the members of the Brewers' Committee, when they visited my laboratory on the 8th of December. Since then Professor Campbell Brown has confirmed the view stated above and made a most interesting research on the subject. With his permission I will read part of a letter which I received from him on the 9th of February, "I have got the most beautiful proof that the needles in the B.O.V. deposit are pure As_2O_3 , essentially. I have seen these rhombic prismatic needles (afterwards proved to be practically free from Calcium and Iron, or only containing traces), break up into strings of octahedra flattened at two sides. These in the solution containing some arsenic, grew into larger perfect octahedra. The needles broke up (like the yellow HgI_2 does) into the smaller red crystals. I find that the formation of the labile rhombic prism form has already been observed from a potash solution supersaturated with arsenious acid." I had therefore found that sulphuric acid contained an amount of arsenious acid much more than sufficient to account for all the arsenic present in the sugars, and that certain brewing sugars contained enough arsenic to explain the large quantity of that substance present in the beer.

Arsenic in
Bostock
glucose.

4877-9. I believe you asked Dr. Coutts to test glucoses for arsenic?—Yes. Dr. Coutts is one of my assistants engaged in this work, and immediately I received samples of glucose from the brewers I asked him at once to test for arsenic, and on the same evening (November 22nd) he found a large amount of arsenic.

4880. Did he test in your own laboratories?—Yes. He found a large amount of arsenic in one of the three samples which had reached us the same day. There was a very marked difference between that sample of glucose and the other samples of glucose we received at the same time.

4881. Is No. 23 of Table 4 (Appendix 12) the specimen?—Yes, the actual specimen. That is a table giving the amount of arsenic found in various brewing sugars, including that one.

4882. No. 23, yellow, 6,000 parts by weight in ten millions?—Making 4 1-5th grains of arsenic per lb. of glucose.

4883. The greatest number I see in this table is 9,500 parts in ten millions, that is to say, 9½ parts by weight in 10,000, in one of the Bostock sugars?—Yes.

4884. Had that sugar been suspected or tested before to your knowledge?—Not that I know of. That glucose we got amongst the second lot of samples which had been collected by Dr. Tattersall. Immediately Dr. Tattersall heard of my finding arsenic in sample 23, he enquired as to the source of that glucose, and the day after I had reported to him went to Liverpool, to the factory from which that glucose had been bought, and collected the other samples of glucose, dark brown, pale yellow, yellowish white, and the various samples of glucose he could obtain from Bostock's factory.

4885. Was that 9½ parts in 10,000 found by a rigorous quantitative analysis?—Yes.

4886. And not merely by estimating the appearances of the sublimate?—Yes, by comparison with standard sublimate; I consider this is a very rigorous analysis because it allows one to find differences of less than 1,000th part of a grain.

4887. That was practically one part in 1,000?—Yes; and this is not over-estimated.

4888. Is that the largest quantity?—Yes: it is the largest quantity we have found in any of the brewing sugars, the next one being 6,000 in ten millions.

4889. Which was also Bostock's?—Yes.

4890. I see in Table 4 a sample from brewery A, with an asterisk, marked 6,000 parts per ten million—No. 23?—That is the first sample which gave us the clue to the origin of the arsenic in the beer.

4891. Do you know for certain the origin in that sugar?—Yes; it came from Bostock's. All the samples which are marked with an asterisk have been found to have come from Bostock or have been obtained from Bostock's themselves.

4892. I see four specimens of sugars from different breweries, two of which contained apparently not a trace, and the other two contained ten and seven respectively in ten millions. Were those Bostock's?—They were Bostock's.

4893. The four almost quite free from arsenic were not Bostock's?—They were not.

4894. Do you know where they came from?—I did know, but I cannot remember now. I should think it was from Garton, Hill, and Co.

4895. Can you tell us more definitely where they came from by referring to your notes?—Yes; and I will let Dr. Buchanan know. I think, however, that it would be better for Dr. Tattersall to give the origin of those samples, as I have really no right to give the origin of any that I received from him. I was doing this work for his authority.

4896. Then I see invert sugars here made from cane sugars by the action of sulphuric acid?—Yes.

4897. You have as much as 2,000 in two of these, both of them from Bostock's?—Yes.

4898. Is some of that sugar crystallisable?—Some of the samples were crystallised. I have not tested whether the others were crystallisable. Some of them were in solution.

4899. I see one of them containing 2,000 was crystallised; was it dry crystals?—It was like honey which has set, crystallised honey which has been kept for some time, opaque, semi-solid.

4900. One of these invert sugars contained practically no arsenic—seven parts in ten millions. Was that from Bostock's?—No. There are two invert sugars not from Bostock's which contained scarcely more than a trace of arsenic.

4900*. Do you mean to say that before suspicion was raised by the recent outbreak it had been found that glucose some glucose employed for beer contained arsenic?—Yes. In some cases a large amount.

4901. Before the recent outbreak and before the present inquiry, you had evidence of arsenic in glucose?—Yes; Monsieur J. Clouet, in the *Annales d'Hygiène Publique*, 1878, p. 145, mentions that, in searching for the source of the arsenic sometimes present in wine, he found that fuchsin is often incriminated wrongly, but that the caramel which is frequently used in conjunction with fuchsin often contains a large amount of the poison.

4902. Caramel is used as an article of food, is it not?—Yes; and for colouring many drinks, cider, wine, etc.

4903. Is caramel pudding made of caramel?—Yes.

4904. Is that the caramel mentioned here?—No, this is commercial caramel. This caramel is made from common glucose and used for colouring, while the caramel used in cakes is usually made from cane sugar, I suppose.

4905. The arsenic which Clouet found in caramel may probably have come in by the sulphuric acid?—Yes. This was certainly due to the use of impure sulphuric acid by the manufacturers of glucose, and he mentions certain glucose factories where such impure sulphuric acid made from Westphalian ores had been used, and where highly arsenical glucose was manufactured. Ritter and Clouet found that the arsenic is derived from impure sulphuric acid which was then not infrequently used in the preparation of glucose from which caramel is made. Arsenic is always more or less abundant in sulphuric acid prepared from arsenical pyrites. In addition to arsenic, glucose frequently contained a large proportion of free sulphuric acid, this being the effect of imperfect neutralisation of the acid after conversion of starchy matters. I have summed up the results of Clouet and Ritter's analyses in Table 12. (Appendix 12.)

4906. I see from this table that the highest amount

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of arsenious acid in glucose reported by Clouet was nine parts per million, or 0.003 grains per lb., and by Ritter, in dark German glucose, 143 parts per million, or 1 grain per lb.—That is so. Clouet gives among the substances which may be contaminated with arsenic through arsenical glucose:—Wine, by the use of caramel prepared from arsenical glucose; cyder, by the use of caramel prepared from arsenical glucose; syrups, by the substitution of glucose for cane sugar; jams, by the substitution of glucose for cane sugar; sweets, by the substitution of glucose for cane sugar; gingerbread, by the substitution of glucose for honey or treacle; tobacco, which is sometimes moistened with solutions of glucose to prevent overdrying and brittleness, etc. Invert sugar is obviously another substance of this sort. It is much sweeter than glucose, and resembles honey much more closely.

4907. We have it on record that glucose was known as early as 1878 to be contaminated by arsenic?—Yes;

4908. Through the use of sulphuric acid?—Yes.

4909. Have you information even before that time?—Yes. I have not been able to get access to Ritter's work, but it is given very fully in Clouet.

4910. Is there any English reference to this?—Yes. Dr. Wynter Blyth has given reference to Clouet's work in his book on foods and poisons.

4911. Is that a book in common use, known to students and experts?—It is known to public analysts, I think. I may say that the reference is given in a footnote which might not attract attention, and there is no proper reference to it in the index, so that it might be easily passed over. A reference is also given to the presence of arsenic in glucose in Thorpe's Dictionary of Applied Chemistry, 1898, art. Arsenic p. 201.

4912. Arsenic is always more or less abundant in sulphuric acid obtained from certain sources?—Arsenic is always present in sulphuric acid made from arsenical pyrites.

4913. The effect of imperfect neutralisation of the acid would tend to leave more arsenic in the glucose than if perfect neutralisation had been practised?—Yes. After being manufactured the acid which has been used for manufacturing the glucose is neutralised, with carbonate of calcium usually, and if the neutralisation is not complete a pretty large amount of sulphuric acid, containing the maximum amount of arsenic, is left in the glucose.

4914. If the neutralisation by lime was complete arsenic would still be left?—Yes, a large amount of arsenic would be left.

4915. But not so much as when the neutralisation is not complete?—I could not give a very positive opinion on that, because I have not examined the sulphate of calcium produced during the process of neutralisation and compared the amount of arsenic taken by the sulphate of lime and the amount of arsenic taken by the sugar. Arsenic is very soluble in solutions of sugar, and possibly more arsenic remains in the glucose than in the sulphate of lime. Therefore it is difficult to apportion what there would be in the sulphuric acid retained in the glucose.

4916. If the neutralisation is not complete there would be a strong acid reaction?—Yes.

4917. Would it be perceptible to the taste?—We had a sample of glucose which had a strong taste of sulphurous acid, but we have not had one which showed any permanent acidity such as is produced by sulphuric acid among the samples we have tested. The glucoses which we have obtained in England were very nearly all neutral.

4918. Practically the neutralisation is generally complete in the manufacture of glucose?—So far as we could ascertain it was complete, whilst in Clouet's time it seems that neutralisation was not carried out well because he found in some cases a very large amount of sulphuric acid. This is given in the table which has been already referred to.

4919. I see in Table 12 sulphuric acid made from pyrites at Westphalia over one half of a gramme of arsenious acid per kilogram?—That is the minimum.

4920. The largest amount of arsenious acid in glucose in this table is .009 of a gramme per kilogram, by Clouet?—Yes.

4921. By Ritter, on the other hand, in dark glucose of German manufacture as much as 1.10th of a gramme per kilogram was found?—Yes.

4922. And that is the largest amount of arsenious acid

in glucose found by even Clouet or Ritter, as shown in your table?—Yes, it makes one grain per lb.

4923. What is the highest in the Bostock glucose?—Six times as much. 6.3-5ths is the highest in Bostock's.

4924. You mentioned the substances that Clouet found contaminated with arsenic. Does he give evidence of arsenic being actually found in them?—I do not think he gives evidence of this, but it seems to be rather by inference.

4925. As a warning?—Yes. He insisted upon the importance of the application of a certain Act which corresponds somewhat to the Sale of Food and Drugs Act, and insisted also on the importance of using that Act very strictly for the purpose of preventing the presence of arsenic in articles of food.

4926. Did he propose legislation?—He said the legislation was sufficient, and should be strictly enforced. He seemed to indicate by his statement that there was legislation, but it required to be strictly carried out.

4927. (Dr. Whitelegge.) Can you say whether the legislation was directed against adulteration or against the presence of arsenic?—It was directed against the presence of poisonous substances. I do not go into questions of administration generally, and I might easily make a mistake, but I can bring the book if it is necessary.

4928. You have kindly shown to the Commission already illustrations of the method of analysis which you follow. Will you now tell us the methods of analysis you adopted?—Many methods are available for the detection of arsenic, but there is considerable difference of opinion among authorities regarding their relative merits. Marsh's and Reinsch's test are generally considered reliable for the detection of small quantities of the substance. The latter is specially useful in the case of organic substances, and though requiring care to avoid errors, is comparatively simple. Marsh's method necessitates in certain cases the breaking up of organic products, and a number of operations, several of which may introduce sources of error or loss of arsenic. Except for the fact that no record of the application of Reinsch's test to the analysis of beer and of brewing material could be found, this method was clearly indicated. There was, however, so great a difference of opinion among experts as to its delicacy and reliability that I found it necessary to make a number of carefully controlled preliminary experiments before adopting it finally. Scherer gives the delicacy of Reinsch's test as being 1-250,000 (Watt's Dict., 1888, I., p. 304. Thorpe's Dict., 1898, p. 194). Taylor says that by this method the 1-150th to 1-200th part of a grain of arsenic may be detected when held in a small quantity of fluid (Medical Jurisprudence, 1873, p. 262). Fleitmann's test is less delicate than Reinsch's test (Thorpe, l.c.). I have satisfied myself by testing solutions of definite quantities of arsenious acid in beer free from any recognisable trace of arsenic, that it was easy to detect 1-100th part of a milligramme, i.e., 1-6,500 grain of arsenious acid in 100 cc. of beer, without concentrating that fluid, so that by Reinsch's method one part of the poison can be rapidly detected in 10,000,000 parts of beer. This degree of delicacy is, I believe, greater than had been suspected before, and distinctly in excess of what was needed for my purpose. Marsh's method did not give us results equally satisfactory, and would have led us in many instances to considerably underestimate the amount of arsenic, judging by the results of a number of comparative experiments. With regard to various brewing materials, the Reinsch's process proved equally satisfactory. An objection which has been offered to the Reinsch's process is that it is applicable only to arsenious acid and arsenites. It has, therefore, been supposed that if arsenates were present in beer, some arsenic would escape detection by the method. It seemed to me improbable that arsenic acid should be produced at any stage of the preparation of sugars or during the brewing of beer, reduction of metallic salts being far more likely to occur than oxidation during these processes. It was also probable that in the event of arsenates being present in beer, the boiling of these salts for an hour in presence of a large excess of organic matter and of hydrochloric acid would bring about some decomposition. This was proved to be the case by testing samples of arsenic free beer, to which arsenate of sodium and arsenate of potassium (in the proportion of one part of salt to 100,000 parts of the fluid) had been added; after three-quarters of an hour boiling a considerable amount of arsenic was found to have been deposited on the copper; a further amount of arsenic was subsequently separated on allowing of a

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more lengthened action. The amount of arsenic thus recovered was about one-fourth or one-third of what would have been obtained had an amount of arsenious acid equal to that of arsenate been added to the beer. The amount of arsenic contained in one part of arsenate of soda is about one-third of what would be contained in an equal weight of arsenious acid, so that only a small proportion of the arsenates, if any were present in beer, would escape detection by the Reinsch's test. The new method of quantitative analysis which I was led to adopt was based upon the following observations. 1st. When five parts of a watery solution containing arsenic are mixed with one part of hydrochloric acid, and boiled for half to one hour, in presence of arsenic-free copper foil, the amount of arsenic precipitated on a surface of copper of definite size is proportional to the amount of arsenic in the solution. This is true within certain limits only, for when the amount of arsenic in the solution is very great, the copper is rapidly covered by a thick spongy layer of arsenic, which is very easily separated, and also possibly interferes with a complete deposition of arsenic from the fluid. To obtain good results it is necessary to use solutions containing less than 1-10th milligramme of arsenious acid dissolved in 100 or 200 cc.'s of fluid, i.e., less than 1 part of arsenious acid in 1-1,000,000 parts of fluid. Such solutions give on a piece or pieces of copper foil offering an aggregate surface of 84 square millimetres ($\frac{1}{2} \times \frac{1}{2}$ in.) precipitates which are suitable for comparison. The arsenic is deposited with remarkable uniformity over the whole of the exposed copper surface. Secondly: Arsenic is unfortunately not the only substance which is precipitated on the surface of the copper, else the different tints produced by deposits of various density might be utilised to estimate the amount of arsenic. To a certain extent this may be done, but no absolute reliance can be attached to such estimation. Various substances containing sulphur are usually present in beer and brewing material; a dark discolouration of the copper is often the result of their presence. Selenium, antimony, mercury, silver, bismuth, platinum, palladium, tin, gold, are also deposited on the copper under the same conditions. This shows the impossibility of estimating the amount of arsenic deposited by a weighing or by a simple colorimetric method. Thirdly. When the deposit of arsenic is volatilised in narrow sublimation tubes, or in small cells of suitable size, the metal is oxidised and deposited in the form of crystalline arsenious acid. The size and number of the crystals are, within certain limits, proportional to the amount of arsenic. From one half of the quantity of copper indicated above, it is easy to obtain a characteristic sublimate from 100cc.'s a solution containing 1-100 milligramme of arsenious acid. Fourthly: Sublimates being obtained in this way from standard solutions prepared by adding 0.00001, 0.00005, and 0.0001 grammes (i.e., 1-100, 1-20, and 1-10 milligrammes) to 100 cc.'s of arsenic-free beer, constitute a scale of three standard sublimates which may be used for purposes of comparison. Of these sublimates the most useful for comparison is the one corresponding to the smallest amount of arsenic, since it is composed of crystals of more uniform size than the others. It is, however, possible to recognise whether a sublimate is about equal to, or more or less abundant than, one of the three standard sublimates composing the scale. The difference between the three degrees are very marked, even to the naked eye, as is shown by the photographs of the sublimates of arsenious acid obtained respectively from solution containing 1-100, 1-20, and 1-10 of a milligramme in 100cc.'s of beer. To obtain quite comparable results it is obviously necessary to use tubes of uniform calibre in all analyses. It is equally important to use reduction tubes of the same size when the Marsh apparatus is used for the purpose of the testing. Whatever method is used the exact size of the tubes in which the reduction or sublimation of the metal is produced should be of a uniform calibre, determined by a central authority and stated in the description of the analysis. Fifthly: When a solution contains an amount of arsenious acid larger than those corresponding to any of the standards, to reduce the amount of arsenic precipitated on the copper it is necessary to reduce the amount of fluid. I have found by experiments that 50cc.'s of beer, containing 0.00005 grammes of arsenious acid give a sublimate proportionate to that given by 100cc.'s of beer containing 0.0001 grammes of arsenious acid. When the fluid contains so large a quantity of arsenious acid that it would be necessary to reduce the quantity to less than 10 to 20 cc.'s, dilution must be resorted to in order to bring the quantity of arsenic within the limits required. Sixthly: The smallest quantity of arsenic

(deposited on copper) which can be used to obtain a definite sublimate depends on the size of the sublimation tube. With a tube the bore of which is less than one-eighth of an inch (3mm.) in diameter, it is easy to get a sublimate with the deposit obtained from 1-100 milligramme of arsenious acid. Seventhly: To obtain absolutely comparable sublimates it is desirable to cause them to form upon a flat surface, against which the gaseous products rise at a right angle. To meet this requirement, I devised a special form of sublimation cone, which gave excellent results. I had at first determined the size of the cone for minimum quantities corresponding to 1-10 milligramme. Owing to the pressure of work, I could not find time to determine the size most suitable for 1-100 milligramme, which I finally adopted as the standard minimum limit. I have therefore been obliged to content myself with the results obtained with thin walled tubes (diameter 3 mm.). Owing to the unequal distribution of the sublimate in such tubes, great care must be taken in comparing them with the standards, but the differences between the three standards are so marked that no material error is likely to occur. It must also be remembered that the intervals between the standard degrees correspond to quantities not exceeding 1-1,300th part of a grain. The above details seemed to me necessary to justify my using a new method of analysis which had not yet stood the test of time. It will be noticed that Professor Dixon had found some difficulty in obtaining by the classical methods satisfactory results in a short time, and with a comparatively large amount of material. The use of such methods would have lengthened our investigations beyond reasonable limits. I found it possible by the new process to obtain sufficiently accurate results with quantities of material not exceeding three or four ounces in any case, and with a small fraction of such quantities in most cases. These results could generally be obtained within two or three hours—a most important matter; they were also easy to control. The same method was applicable to all products under investigation. It must be noted that the aim is not to obtain a complete precipitation of all the arsenic present, but to get a precipitate proportional to the actual amounts.

4929. What was the exact procedure which you adopted?—It was as follows: First. Preliminary Test: 100 cc.'s of beer, to which is added pure hydrochloric acid (1 part of acid to 5 parts of beer), are boiled in the presence of two pieces of copper, measuring exactly $\frac{1}{2}$ in. square each. If after boiling this gently for one hour, the copper remains absolutely bright and unaltered in colour, the beer is considered free from any material trace of arsenic. For the purpose of confirmation, 200 cc.'s of beer are submitted to the same test. For experimental purposes, 500 cc.'s and even 1,000 cc.'s of beer have been used in some cases without any arsenic being discovered (Tables I. Sample II.)*. When the copper is dulled and shows any alteration of colour, greyish red, purplish red, steel blue-black, or dull black with spongy appearance, and when the deposit gives a sublimate of arsenious acid, arsenic is certainly present in the beer. Second. To make a rough estimate of the amount of arsenic present: One piece, or a fraction of a piece of copper, according to the colour, is sublimated in a small sublimation tube, with thin walls. If crystals of arsenious acid are obtained, the sublimate is compared with the 3 standard sublimates. If the sublimate corresponds to one of the standard sublimates, it is assumed that the quantity of beer corresponding to the quantity of copper used contains about the same amount of arsenic as 100 cc.'s of the standard solution indicated by the standard sublimate. Thus if $\frac{1}{2}$ of 1 copper gives a sublimate corresponding to the sublimate obtained from 1 copper used in testing a solution containing 1-100 milligramme, it is assumed that the beer tested probably contains 1-100 of a milligramme in 25 cc.'s. Third. Control and final estimation: In a case such as the one given above, 25 cc.'s of the suspected beer are tested as before (2 pieces of copper being used). If from one copper a sublimate equal to 1-100 a milligramme is obtained, the previous estimate is considered satisfactory. If the sublimate is more abundant and does not exceed the 1-10 of a milligramme standard, the amount of sublimate is approximately fixed by careful comparison. In the improbable event of the sublimate being more abundant than the 1-10 of a milligramme standard, a third test is made with a smaller quantity of beer.

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Prof. Delépine. 4930. (Sir William Church.) With regard to what you say of the reduction tubes, you mean as an estimation of quantity?—Yes.

Mar. 1901. 4931. It would be immaterial for the estimation of its presence?—By no means. By using tubes of sufficiently large size such as I have seen used by several people who have made analyses, it would be very easy to overlook a very material amount of arsenic.

4932. From the arseniuretted hydrogen passing through without leaving any deposit at all?—My remark did

not apply to the Marsh test, although it would be probably quite as easy to make a mistake with Marsh's test as with Reinsch's test. With the Reinsch's test, although one may get a good precipitation of arsenic on the copper, if this arsenic is sublimated in a tube a little over a quarter of an inch in diameter it becomes practically impossible to obtain a clear sublimate unless the amount of arsenic be very large indeed. A great part of it escapes from the tube. There are convection currents which carry up the vapours or small crystals before they are deposited.

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Mr. HENRY WELD BLUNDELL, called; and Examined.

H. W. Blundell. 4933. (Chairman.) You are chairman of the Cornbrook Brewery Company, Limited?—Yes.

4934. Your brewery were customers of Bostock's?—Yes.

4935. And were more or less concerned in the late epidemic?—Yes.

4936. Is glucose used in your brewery?—No; not at all. It never has been.

invert sugar in brewing. 4937. Is invert sugar used either for brewing, priming, or for both?—It is used for brewing, but not for priming, except in the case of stout, when we use a very little, but in all other brews we never use any priming whatever, and never have done, but only use invert sugar, putting it in the copper, and therefore it goes through the whole process of brewing, and not, as is usually done, added at some other period.

4938. It goes through the process of fermentation?—Yes; as well as being boiled in the copper.

4939. Prior to the fermentation?—Yes; the very first process. It is put in the copper with all the wort, and therefore it is boiled, and then passes through the filtering process through the hop back, and then over the refrigerators, and so forth, passing on to the fermentation. Therefore we attribute to that the fact that we have had very much less arsenious acid than theoretically we ought to have had. We attribute it to the fact that it has been precipitated. The boiling process, the filtering process, the fermentation, and perhaps the deposit on the coolers and refrigerators has resulted in a certain amount being carried off.

4940. The fermentation carries off some of the arsenious acid that was in the invert sugar?—Yes, I think so.

4941. In what proportions were you using invert sugar in different kinds of beer between June and the end of November last?—Between about 8 per cent. and about 12 per cent.

4942. Eight per cent. of invert sugar and 92 per cent. of malt?—No; of total materials used.

4943. Including the water?—No; the materials put in for use in brewing.

4944. That is to say, 8 per cent. of the total materials, the total materials being—?—Malt and other ingredients. We use a certain amount of raw grain.

4945. (Mr. Cosmo Bonsor.) Flake malts?—No; maize grits.

4946. (Chairman.) Those other materials would be called malt substitutes?—Yes; malt and malt substitutes.

4947. How much malt would be in that percentage?—It would be rather difficult to say, it varies so much in all kinds of brews. I have calculated that only from the point of view of the proportion of sugar to the total materials used. If you like, I would mention the quantity of invert sugar containing the arsenic to each barrel, it represents about 4lb. 7oz. in single X beers. In the case of other qualities it was rather more, 5lb. 6½oz.

4948. (Mr. Cosmo Bonsor.) What would be the gravity of that single X beer, 19?—Less than that; about 16. A quarter of malt would produce about 4 barrels and a-half.

4949. (Chairman.) The alcohol reduces the gravity, but the other substances increase it?—Not necessarily. I refer to the gravity of the worts before fermentation. It is the sugar matter which the yeast has to act on afterwards.

4950. Is that 4lbs. of invert sugar per barrel of 36 gallons the maximum or minimum average?—In

some beers, for instance, in what we call best mild beers, there is as much as 5lbs. 6½oz. of sugar to the barrel, or rather more.*

4951. How much of the invert sugar used at this period came from Bostock's?—At this particular period we were using nothing but Bostock's. We have had for some years past contracts with the two producers of invert sugar, Garton Hill's and Bostock's, and we pay the same price for the material to both manufacturers. In both instances we got the best, and we had about equal quantities from each. Sometimes we were getting deliveries on one contract and sometimes on the other. It so happened that between about May or June last and November we were running on Bostock's contract. The contract with Garton Hill had dropped for the time being.

4952. (Sir William Church.) As early as May?—I think I am wrong, I find it was July.

4953. It is a very important thing to know when you changed?—It was only by accident we went from one to the other; it was about July.

4954. At present we have not any mischief arising so early as May?—This is quite irrespective of any mischief. In July we started on Bostock's contract and suspended the other.

4955. (Chairman.) Had you any reason for going from the one to the other contract?—None whatever. It was a pure accident.

4956. It was not a question of rival estimates?—No; they were precisely the same. The price we paid for both Bostock and Garton Hill's has been the same for some years.

4957. Had you any expert knowledge in your place of the qualities? Was the one supposed to be as good as the other?—Yes; we had them periodically analysed, and we judged best by the results of the mash tun, by the specific gravity of beers produced from the use of these materials. But, of course, we never suspected that arsenic would be there, and therefore never had it analysed for arsenic.

4958. Your analysis consisted in determining the brewing value of the ingredients?—Yes; and what quantities of dextrose and levulose, and their freedom from any other deleterious matter.

4959. Your analysis was partial?—It was purely for our own purposes in the brewery.

4960. How long had your firm been Bostock's customers, more or less?—For a great number of years—about ten years.

4962. Was there any invert sugar used for brewing 10 years ago?—I could not say, but we did not use it more than 10 years ago.

4963. So that from the beginning of your use of invert sugars you took it sometimes from one and sometimes from the other?—Sometimes from Bostock and sometimes from Garton Hill.

4964. Never from any other maker?—No.

4965. After the discovery of arsenic what steps were taken by your brewery?—At our first meeting of the Brewers' Association which has been referred to by discovery of other witnesses, we were informed for the first time that something was wrong with some of the beers. We had heard before that there were some beers brewed by some breweries which were causing a certain amount of sickness, but we presumed it was only from some defect in the brewing. We discovered on this date—which I think was the 23rd November—that there was something more than that, something seriously wrong. The next morning, the 24th, a

Action by
brewery on
discovery of
arsenic.

* Note.—Further details since submitted by Mr. Blundell appear in Appendix, No. 13.

Mr. H. W.
Blundell.
29 Mar. 1931.

Saturday, I went off myself to Owens College to see a very able chemist there, Mr. Kirkby, an analyst, to ask him to analyse our beers for arsenic, which we heard for the first time that morning in the newspapers was known to be present in some samples of beer. At that time we had not the smallest suspicion we had any, and we simply went there to satisfy ourselves of its freedom from arsenic. Dr. Kirkby analysed it, and in the course of a couple of hours asked us to meet him, and he told us that there was arsenic present. He immediately asked me whether I used Bostock's sugar, and I told him we did, and he said, "That is the substance which contains it." He showed me a sample by some process I cannot remember now—it was neither the Reinsch test nor Marsh's test—but by precipitation on blotting paper. He showed me the stains produced by the deposit of arsenious acid in the beers of other brewers which he did not name, and compared ours with it, and the conclusion I came to was that we undoubtedly had the arsenic present, but in very small proportions, because the stain was almost colourless, whereas the others were distinctly brown stains. That was the first intimation that we had of any arsenic. I then went back immediately to the brewery, and stopped brewing any more with Bostock sugar, and from that time we produced beers without any sugars at all for a week or ten days, and then we went on with our contracts with Garton Hill. I was still, of course, under the impression from what I had seen and heard that by using no glucose and a small quantity of invert sugar there was no harm in our beers at all, but two or three days after that it appeared in the papers there was danger resulting from the use of any, and it was supposed then that deaths had resulted from it, and we stopped sending out any beers at all containing Bostock's invert sugar. That was three days afterwards, Wednesday, 23rd November. We then sent a circular out to all our tenants and to all our customers with some labels, instructing them to fasten on our barrels a label stating "Not to be consumed," and then as soon as possible we sent round our own travellers and carters and clerks to pour all the beer down the drains, that contained any of Bostock's sugar.

4966. Were you able to do that to other than your own tenants?—We followed the beers to publicans and free customers, and submitted as soon as we could beer without Bostock's sugar for what they had poured away, but we found very little difficulty. People behaved exceedingly well. The only difficulty we had was that some of the tenants refused at the beginning to send their beer down, because they said they had never heard of anybody who had suffered injury from it, and did not believe there was anything wrong with it. We insisted upon it, and the beers were all poured down.

4967. Did you have any of those beers analysed for yourselves?—Yes; I had a good many at the beginning. I thought, of course, it might have been only one particular sample of Bostock sugar. We all did, in fact; we thought it might have been an accidental consignment, and as we got small consignments over at a time I concluded it was only perhaps one or two brews. But we had a number of beers analysed, and they showed an extraordinary difference in the percentage of arsenic present; some of them showed the faintest trace only. In fact, the analysis given to us would show that it was practically free in many instances down to '01 of a grain of arsenic to a gallon of beer, which was practically negligible; others, had more. In order to verify the quantitative analysis I took the sample which contained the most of any, '2 or 1-5th of a grain per gallon, and sent it to a London firm, one of the best firms we could find, to verify the analysis, and they reported—I do not mention their names, for obvious reasons—but they reported they had analysed it several times, and they gave us a certificate that there was no trace whatever of arsenic in the beer. I do not mean to allege that the sample contained no arsenic. I take it for granted it must have been there, but I only mention that to show the difficulties that existed in discovering it.

4968. That beer was the beer you had tested in Manchester?—Yes.

4969. It showed traces in Manchester?—Yes; and we sent it to a well-known London firm, and that was their certificate in return—perfectly pure.

4970. The beer that contained 1-5th of a grain per gallon was sent to London?—Yes.

4971. (Dr. Whitelegge.) 1-5th of a grain was not regarded as a trace?—No. That was a case of the worst we had. I sent that to London to obtain a quantitative analysis of arsenic, feeling that it might be a necessity to take precautions.

4972. (Chairman.) That illustrates the great difficulty in getting a trustworthy test?—Yes.

4973. Has any action been taken by any sanitary authority against any retailer of your beer?—In Manchester and Salford and districts around there have been four summonses taken out against tenants of ours beer for containing very small amounts. They put it, "in excess of so much"—I cannot remember what the quantities were, but they were very small. It may have been only for the purpose of prosecution. All the cases have been deferred pending the decision given upon the Appeal upon a case that has been stated for the higher Court as to the particular clause which was concerned in the summons. Mr. Fletcher Moulton, who defended the first case, not ours, contended that the summonses were taken out upon the wrong clause. I think it was the third clause instead of the sixth, and a case was allowed to be sent to the higher Courts. All our cases, therefore, are dependent on that particular decision.

4974. (Dr. Whitelegge.) Were those cases taken against your company or against the tenants?—Against the tenants. The summons was taken out against the tenant alone.

4975. But you defended?—We have not defended them, because they were not even brought into the Court. The tenants were told that their cases were deferred until the appeal was decided. I take it that if this decision in the first case by the Stipendiary of Manchester is upheld these prosecutions will be continued.

4976. (Chairman.) Were there any prosecutions outside Manchester?—One outside Manchester in an out-district.

4977. Did that go on?—Yes, it was a case at Radcliffe, where a small fine was imposed.* A barrel had been left of the old brew; the whole of the brew had been thrown down the drains, but this particular barrel was left there, not for consumption, and the tenant had never sold any of the beer to anybody at all, but the policeman came into the cellar and saw the barrel there, and asked why it was it had not the labels on with the others warning them not to be consumed, and he said: "Well, it is there, but I have not sold any of it." He was then drawing from other barrels free from arsenic, but having it in his possession I suppose he was prosecuted and fined a small fine, but none of it had passed into consumption at all. The barrel was full.

4978. (Chairman.) If the label had been put on there could not have been a prosecution?—I do not know whether there could be or not.

4979. (Mr. Cosmo Benson.) Under what Act of Parliament was this justified?—I do not think it is justified at all. I think it is perfectly illegal. It was not for sale, but the policeman exercised his power and the tenant did not like to refuse.

4980. (Dr. Whitelegge.) Why was it there?—It was sent out before the discovery of arsenic in beer; the reason for it not having been put down the drain was that we believed that that particular brew was free from arsenic. It had been tested and found free; that particular brew was believed to be safe, and therefore this brew remained for a few days longer than the others. Then it was found that all Bostock's beers were contaminated. But the moment we found that also must contain arsenic because it was brewed from Bostock's, it was ordered to go down the drains as well.

4981. (Mr. Cosmo Benson.) Was the prosecution in that case under the Sale of Food and Drugs Act?—Yes. The constable went down to the cellar and insisted upon the beer being drawn.

4982. Was he a constable or an inspector of the County Council?—I think he was an ordinary constable.

4983. An ordinary police constable?—Yes; sent out

* Note by Witness.—My manager informs me that the case in which the inspector took a sample from the barrel in the cellar occurred in Rochdale, not in Manchester, as stated.

Divergent
results of
different
analysts.

Mr. M.
Blundell
29 Mar.

H. W. for this express purpose under the Sale of Food and Drugs Act for the purpose of taking samples.

4984. (Chairman.) And a sample was taken?—Yes; he was not satisfied with taking what came through the taps and offered to the public, but insisted on going down into the cellar and chose this particular barrel from which he took this sample. Then he insisted upon the tenant taking the money for it so as to comply with the Act.

4985. The tenant might have refused to take the money?—He might have refused, but a tenant does not like to refuse an officer, as he calls them.

4986. (Mr. Cosmo Benson.) I am asking because I wanted the Commission to get the knowledge whether the prosecution was under the Sale of Food and Drugs Act? What I anticipate is that probably the constable was practically authorised by the local authority, acting under the Sale of Food and Drugs Act?—Yes, undoubtedly, I think he was.

4987. He did not go as an ordinary police constable?—No, he went practically as an inspector under the Sale of Food and Drugs Act.

4988. (Chairman.) Does your analytical chemist have a specimen of each brew?—Now he does. Since the 26th November a sample of every brew has been sent to the analyst, who analyses it and reports.

4989. Who is your analytical chemist?—Dr. Miller.

4990. Have you had him from previous years?—Yes, for many years he has analysed for us at various times.

4991. He has a laboratory of his own?—Yes, a laboratory of his own in Manchester.

4992. He now has a specimen of each brew?—Yes, of each brew.

4993. Where are these samples taken from, from barrels or from vats?—As a rule, from the fermenting rounds or from the racking vats. The racking vats are the last vessels into which the beers are run before going into the barrel.

4994. The racking vat is after it has been fermented and left to settle?—After the fermentation it is brought straight from the fermenting rounds into a large vessel containing 150 barrels or so, and there it remains for an hour or two, and then the beer is drained into the trade casks. At that point the sample is usually taken.

4995. Does that vat leave any residue in the bottom when the beer is drawn off?—Yes, it leaves a certain deposit at the bottom which goes down the drains. The vats are cleaned out every time they are emptied, and the washings run down the drain.

4996. What materials do you purchase under a guarantee of freedom from arsenic?—Practically we purchase all our materials, our malts, and everything under a guarantee of purity.

4997. (Dr. Whitelegge.) Does the guarantee mention arsenic in particular?—Arsenic in particular.

4998. (Chairman.) That is since November?—That is all.

4999. Previous to November arsenic was never mentioned?—Never mentioned and never thought of.

5000. Is there a general guarantee or is there a separate guarantee for each separate consignment?—I think for every consignment; there is a printed guarantee on every invoice.

5001. I understood that you use some grain mixed with malt?—Yes, maize grits we use, a form of maize; maize cut up by machinery and mechanically treated merely for convenience; it comes from America.

5002. Freed of the husk?—Yes, and also of the acrospire, the germ which contains flavour and oil.

5003. That is taken off?—Yes, it is taken out by the machinery. It is on the same principle as the degerminating machinery used everywhere now for wheat.

5004. Similar to what is used for the malt?—We do not use it for malt. Malt is merely crushed.

5005. In the brushing and screening there is a process of taking off the radicle, is not there?—Yes, that is the rootlets that grow outside. After the barley has been grown on the floors of the maltings, and cured in the kilns, the rootlets are brushed off, but the acrospire is there still. That is cut out in the case of the maize.

5006. For what classes of beers do you use maize?—For all the lighter beers, and all the running beers, and occasionally for some of the others.

5007. Have you ever had the maize tested for arsenic?—I think we certainly had it tested once, but of course it is pure grain.

5008. Since November have you had it tested?—Yes.

5009. What about flaked maize?—We have never used any.

5010. You have already answered the question that you used maize and have tested it for arsenic?—I think we have tested it for arsenic and found it quite free.

5011. Maize grits are simply the grain?—Pure grain.

5012. Which has not been submitted to any other treatment except the mechanical treatment you have described?—That is so.

5013. Do you use prepared or flaked maize?—No, none at all.

5014. Some forms of prepared maize may have undergone a chemical process with sulphuric acid, may not it?—I should think so, but I have no experience.

5015. But it is not the maize you use?—No, not the maize we use at all.

5016. After giving up the use of Bostock's products were any of your beers condemned as arsenical either by your own analyst or by others?—No, none at all.

5017. Have you found it necessary to destroy any beers except those in which Bostock products had been used?—None at all.

5018. Has your brewery its own maltings?—No, we have not.

5019. Do you ever test the malt?—Yes, constantly.

5020. You test it for its value as malt?—Also for arsenic.

5021. That is since the scare you test it constantly for arsenic?—Yes.

5022. Have you found arsenic in any of the malt you have tested?—I think all malt contains an infinitesimal trace; I may be wrong, but I think it is pretty well accepted now that if they know how to find it all malt probably contains an infinitesimal trace; but that is probably being got rid of, and will in the future be eliminated entirely by kiln drying or treating with absolutely pure anthracite coal.

5022*. (Sir William Church.) How is that to be attained?—I think some of the mines in South Wales are absolutely free. I met a gentleman the other day who told me his was, and he is selling large quantities. Before it was always a little impure.

5023. Absolutely free is strong. I would not venture to say that may not be the case, but anthracite coal we have already been told by those who know does contain in its fissures sometimes arsenic, and the public should not be too much impressed with the idea that anthracite is absolutely free?—No.

5024. (Chairman.) Do you do any brushing or screening of the malt?—Yes. It is screened to begin with at brushing and the maltings where we buy our malt, and it is again screened in our process. It is brushed and screened in the process in a Nalder machine which brushes and cleans it and blows out the dust before it is ground and sent up to the mash tun.

5025. Have you in recent times ever tested the malt dust?—I do not think we have tried it. We do not collect it. It is blown into the chimney.

5026. May any of it blow about through the brewery?—No, it is drawn up into the main shaft of the chimney, where it gets consumed.

5027. It would be a satisfaction to take some of it and test it?—I think it would.

5028. If there was any arsenic on the malt at all it would be, I believe, in the outer crust?—Yes.

5029. And therefore in the test it would be found in a large proportion?—Yes. But we find our beers are so free from arsenic that we have not thought it necessary to look for a shadow of it, especially as now our maltster is producing all his malts for us with anthracite, and therefore absolutely free, I take it, or nearly as free as possible.

5030. (Sir William Church.) Although you have not your own maltings, you deal with one or more maltsters; you do not buy in the open market?—Not as a rule. We do for some classes of our malts, for the best pale ales, but nine-tenths of our malt is malted for us by a very well-known firm in Lincolnshire, who malt

Mr. H. W. Rundell.
29 Mar. 1901.

No non-Bostock beer condemned on account of arsenic.

Drying malt with anthracite recommended.

- Mr. H. W. Blundell. expressly for us under our own special conditions of growth and curing.
- 29 Mar. 1901. 5031. Do they supply it to you brushed and screened?—Yes.
5032. And you also brush it and screen it yourself?—Yes.
5033. Though it has been brushed and screened by the maltster, you give it an additional brushing and screening?—Yes. That is to say, we pass it through a machine that does that. We do not expressly put it through a machine for that purpose, but the machine it passes through, which is a separator of the larger grains from the smaller ones, contains a brushing machine as well, which takes as far as possible all the dust and combs off.
5034. (Chairman.) There is some dust proceeding from that process?—Yes; some considerable amount of dust is collected from that, and that passes away into the main chimney stack of the brewery.
5035. It would not be a very expensive or troublesome thing to occasionally test that dust that passes up the chimney?—No, it would not.
5036. Have you found it necessary to make any changes in your fuel?—No, we have not.
5037. With regard to this brushing and screening, are you doing that now more frequently?—No; about the same.
5038. You have been always doing that?—It has been part of our process for some years.
- Brewing books show origin of ingredients in each brew. 5039. Do your books show where the materials used in the manufacture of any particular beer were bought?—Undoubtedly.
5040. Do your books show what quantities were used—the malt from one place, malt from another, and so on, in each brew?—Undoubtedly we could trace everything.
5041. Your maize from one place, and maize from another?—Yes.
- But returns to Inland Revenue do not. 5042. Do the returns you make to the Inland Revenue give them this information?—No; I do not think they do. I do not think the returns give the information. All the returns to the Inland Revenue given are the quantities of the various materials required by them, but nothing as to where they come from—the malt, maize, invert sugar, and the rest.
5043. In the case of your tied houses, do you always know what brews are on the premises at any stated time?—Undoubtedly.
5044. (Sir William Church.) During the autumn of last year did you notice anything at all in connection with your yeast?—Nothing at all.
- Interchange of yeast between breweries. 5045. You had not to get fresh yeast?—No.
5046. That does take place, the interchange between breweries of yeast?—I would not say we never do so, but it has been always our practice to periodically get a slight change of yeast, not a complete change, but about 50 lbs. or so at a time.
5047. To add new yeast to strengthen your yeast?—Yes.
5048. But you had not to do that last autumn?—No; not more than usual. Every few months perhaps we have a few pounds from some brewery.
5049. (Mr. Cosmo Bonsor.) How much beer did you have destroyed, roughly?—Is it necessary to say it, or shall I put it in?
5050. Was it a considerable quantity?—Yes; it was a considerable quantity.
5051. Did you make any application to the Inland Revenue for a rebate?—Yes.
5052. Did they give you one?—Undoubtedly.
- Rebate of duty on arsenical beer destroyed at the brewery, not if left the premises. 5053. They gave you a drawback?—On all the beers we destroyed inside the brewery.
5054. Not on the beers outside?—No; we did not ask for it, principally because we knew we should not get it.
5055. Why?—We were informed. I went to see Sir Henry Primrose, and he said there was not the least chance of allowing the rebate of the duty upon any beer that had gone outside the brewery, gone out of our hands.
5056. Might I ask if you export beer? I do not know whether you ever do export beer. If you sent it on board, they will do it?—Yes.
5057. If you took this beer out of your customers' cellars, and put it on a barge, and took it out to sea, you could have got a drawback?—I think if we passed it through one of the seaports for the purpose of export we could have done it, but I do not think it would be expedient to have done so, and they refused to allow the rebate for what was put down in the customers' cellars.
5058. They refused?—They refused. The Inland Revenue said there were objections to it, that the law did not provide for it, and that there was no chance of our getting it; all that we did was to get the rebate upon the beers that had never gone outside our own premises, and went down the drains.
5059. Did the Inland Revenue officers draw samples of your beers during the process of brewing, not for the purpose of collecting the revenue, but for the purpose of protecting the public?—Not that I know of.
- 5059*. Not when they got the knowledge of the epidemic?—I do not think so; only the ordinary samples for specific gravities.
5060. None for the protection of the public?—No.
5061. (Sir William Church.) Had you noticed that there was an unusual amount of sickness among your employees, or not?—No; there were only one or two of our men of all the people we knew who had drunk our beers that had suffered. We could not trace those to our beer; they were people not living in our districts, but elsewhere. Our carters, who undoubtedly are the heaviest drinkers about the premises, were not sufferers, and there was not a single one in the least unwell.
5062. You say definitely your notice had not been attracted to your workmen, which was not the case with other places?—That is so.
5063. (Mr. Cosmo Bonsor.) I think you attribute that to the fact that you use the incriminated material in brewing and not in priming?—Yes; and also to the fact that we used no glucose, and only invert sugar. There was one question, I think, in the circular; we were asked to express an opinion as to the mode of avoiding it in future. I should like to have pointed out that from the cross-examinations and expressions of opinion, I judge a great many are inclined to believe that all danger of arsenical poisoning could be got rid of, or all dangers avoided by a system of constant analysis; but I take it that the cause of the whole trouble, and the one that ought to be attacked, is the starting point of guaranteeing the chemicals used in the manufacture of the materials. In other words, that the sulphuric acid manufacturer who is in the position of selling his stuff as sulphuric acid, should not be allowed as he is at present to sell his acid containing as much arsenic as he likes without a notice that it contains a dangerous poison perhaps known only to himself. He sells that to the sugar manufacturer; he sells it to everybody else all over the country, and I am strongly of opinion that the poison of arsenic is far more disseminated than anybody suspects. The manufacturer of sulphuric acid—the manufacturer of any other acid—can sell his product containing a poison which is not apparent on the face of it, without stating in any kind of way, although he knows it himself, that it does contain a particular poison. If the sulphuric acid manufacturer were in a position of being obliged by law, if he sold anything containing arsenic, or a hydrochloric acid manufacturer, if it contained strychnine, were such a thing possible, to place on the outside of his invoice that it did contain such a thing, the public would be protected wherever that went. I am very strongly of opinion that sulphuric acid is the cause of a large amount of danger and deaths amongst sheep stock in agricultural districts. I happen to be connected with a very large estate in Dorsetshire, which I am in a position of looking after as committee. As everyone knows, the root crops there are grown upon bone phosphate, and bone phosphate is made by treatment of bones by sulphuric acid, made from pyrites, which now everybody knows contains an enormous quantity of arsenic. It is perfectly well known in all the sheep farming districts that sheep are constantly dying whilst fed on roots from reasons nobody knows anything about. I know that the best farmers are the ones who suffer most from the loss of sheep when they are feeding on the roots, and the only way in which the deaths are put

an end to is by the sheep being taken off the land and put on grain food, hay, corn, and other things. Veterinary surgeons have been called down, and the most experienced farmers cannot tell what the cause is. I have given orders to have the urine collected from sheep which have died under those conditions, and I understand from analysts whom I have discussed this very question with that there is not a doubt that in consequence of the sulphuric acid manufacturers selling their acid without the obligation to divulge the presence of arsenic the poison is carried into the super-phosphate without the manure maker knowing it, and probably rendering the roots grown on it injurious to the stock. The danger would be entirely removed in the brewing industry if the original manufacturers of the materials used in the chemical manufacture of these sugars were liable to criminal prosecution if they did not state the presence of the hidden poison.

5064. (Sir William Church.) Of course, that is a very ingenious supposition, and one that deserves to be considered; but have you any evidence whatever to begin with that a turnip or a mangold will assimilate arsenic or take it up into its tissues? Arsenic acts as a strong poison to vegetable life as to animal life?—I was told by a chemist that arsenious acid being soluble would probably be taken up by the roots.

5065. But you have not got any evidence at present?—No, none at all at present.

5066. It is only an opinion?—Yes, it is only an opinion which has been corroborated by opinions of analysts.

5067. It is worth attending to, but you have not anything in the shape of evidence?—No. I merely illustrated that to show the danger of allowing the manufacturer of a contaminated acid to sell it without notifying to his customers the presence of poison. The whole of the danger to the public through the agency of beer would be removed by forbidding—which is the natural course to take—forbidding the chemical manufacturer to put the poison in without telling his customers, and punishing him if he does it.

5068. (Chairman.) You are having some experiments made on live stock?—A chemist has undertaken to analyse. It was Dr. Stevenson or Dr. Luff who originally advised me, and they told me the best way for discovering it and tracing it would be to get the urine taken from four or five sheep that had died, and if I sent it up to him he would analyse it, and if it contained arsenic he would proceed with further analysis.

5069. Is that being done?—I have given instructions to have the urine collected.

5070. If you get results will you kindly state them to Dr. Buchanan?—I will, certainly. It is late on in the year now, and it all depends on whether any stock suffer at this time of the year. The stock are not so much on roots as they would have been a few months ago.

5071. Might it not be as well to have some of the roots tested for arsenic?—Yes, I think it might. I will have that done.

5072. It would be desirable and important, and if you get results you might kindly send them to Dr. Buchanan?—I will.*

* The following letter has since been forwarded by this witness:—

The Cornbrook Brewery Company, Ltd.,
Chester Road, Manchester, May 16th, 1901.

SIR,—When I gave evidence at Manchester before the Royal Commission upon Arsenical Poisoning, I stated that farmers were liable to many losses amongst sheep stock during the winter months, when sheep were being fed on roots, and that I had reason to suspect that these losses were probably caused by arsenic introduced into the roots through the fertilisers (superphosphates and other bone manures), which were, I believed, largely manufactured with sulphuric acid highly contaminated with arsenious acid.

His Lordship, the President of the Commission, desired me to make some investigations in the matter, and to report to the Royal Commission.

I now have the honour to report that I gave instructions to my agent upon the Lutworth Estate, in Dorset, to send me up to London some samples of superphosphate, and, on the suggestion of Dr. Stevenson, to procure for me, if possible, some urine from the bladder of a sheep that had died upon the roots.

I was successful in procuring a very small quantity

5073. (Dr. Whitledge.) You suggest that fermentation might partially remove the arsenic?—I have only the supposition that the fermentation and the processes in brewing eliminate it because I have had our beers analysed, and I find only a very small trace in the worst cases. I have the authority of Mr. Gordon Salamon and others for stating that a barrel containing 4lb. or 5lb. of invert sugar ought to contain more arsenic than it actually does. I infer, therefore, that in the process of fermentation it has been deposited somewhere.

5074. Basing that inference on the fact that it has disappeared somewhere or other?—Yes, that is it. I cannot possibly say it would be so.

5075-6. The suggestion has been made that the colour of Bostock's glucose may have been different in the later stages when it was presumed to contain more arsenic. Can you tell us anything about that?—I do not think that is at all likely. I should like to ask my brewer upon that point.

(The Brewer.) Certainly not; in the last two or three months Bostock's sugar was more regular in colour than it had been for some time. Some 15 or 18 months ago we had to make complaints about the colour.

5077. It was not dark at all?

(The Brewer.) No.

5078. (Dr. Whitledge) (to the Witness.) You told us you obtained guarantees of malt. Did you obtain any guarantee with hops?—We did at the beginning, but I think the hop merchants rather protested against that, as they had nothing to do with the manufacture. They said they were simply middlemen.

5079. You do not obtain any guarantee now?—No; we have had some analysed, but we do not find there is anything in it.

5080. With negative results?—Yes.

5081. Did you send out any guarantee with the beer to customers?—We have done so since this scare, but we intend to desist. It is a great source of trouble. What we intend to do is to tell all our tenants that we do guarantee it to save having to put the labels on.

5082. To substitute a general guarantee for a specific one?—Yes.

5083. Do you intend to give it to your tenants only or to everybody?—We intend to give up the specific guarantee and give the general one. If they wanted it we should always supply it.

5084. The arsenicated beer brewed with Bostock's sugar was all destroyed?—Yes.

5085. Was it destroyed at once?—It was only destroyed as it was returned to the vats and measured for the purpose of getting the Excise revenue back, but it was all destroyed in the houses as soon as we possibly could.

5086. But for the purpose of rebate was the beer retained on the premises longer than it would have been otherwise?—I think so.

5087. Can you say how much longer?—I should think there were two thousand barrels in the brewery at the time the scare occurred, and it would probably all have gone out except perhaps the pale ales within a week, and as it was a good deal of it was kept until the 28th

of urine from a ewe that had suddenly died under the typical conditions referred to. The animal was apparently quite healthy, and in good condition.

The fertilisers and the urine were forwarded by me to Mr. A. Gordon Salamon, who reported that one of the samples of manure was heavily charged with arsenic, and that the urine contained more than a trace of arsenic. The quantity of liquid was very small, under a tablespoonful, and a quantitative analysis was therefore impracticable. I am informed that it was the opinion of the experts who saw the mirror produced, that the animal probably died from the effects of arsenical poisoning.

As it is impossible to believe that the arsenic could have been taken by the sheep except in the manner suggested, I think the evidence is sufficient to justify very careful investigation. The season is too advanced to allow of any examination of roots, but I hope to make further experiments next winter.

I have the honour to be, Sir,

Your obedient servant,

HENRY WELD BLUNDELL.

The Secretary,

Royal Commission on Arsenical Poisoning.

Mr. H. W. Blundell,
29 Mar. 1901.

Colour of Bostock glucose not unusual.

A general guarantee of purity of beer to be given to customers.

Question of rebate of duty delayed destruction of beer.

Mr. H. W. Blundell. December, when the last of the beer was put down the drains, after the Excise had taken the quantities and samples.

29 Mar. 1901.

5088. Was there delay on the part of the Excise authorities or simply the difficulty of dealing with it?—I think the Excise officers offered us every facility, but we had to brew without cessation to make up the loss of beer we had put down the drain, and we could not spare the large vessels into which we had to pump the beer to calculate the quantities.

5089. You have large stores at other centres than Manchester?—Yes.

5090. What was done with the arsenicated beer?—It was all put down the drains in the stores.

Mr. G. E. COWELL, called; and Examined.

Mr. G. E. Cowell. 5095. (Chairman.) You represent Wilson's Brewery Company?—Yes.

5096. You speak to the amount of Bostock's product used in your brewery. Can you give particulars in writing to the Secretary?—I have done so.

5097. How long had your firm been Bostock's customers?—About three years and a half.

5098. In respect of the action that you are now taking since the arsenic danger has been discovered, what samples of your brewing materials do you now submit to your analyst?—We have submitted malts constantly, and the sugars.

Guarantees now obtained of certain brewing materials. 5099. Brewers' sugars and glucose?—Yes, and we got a guarantee with each consignment of all the materials with the exception of hops.

5100. Have you brought any specimens?—No.

5101. Malt, invert sugars, and glucose. Are there any other materials?—No; those are the main things.

5102. Have you got a guarantee with maize?—Yes.

5103. Not in other substances?—No.

Brewing books would not show origin of ingredients in every brew. 5104. Do your books show you where the materials used in the manufacture of any particular beer were bought, and in what quantities they were used?—Our books would show where the materials were bought, but in the case of invert sugars we could not tell you positively how it is all disposed of. We did not discriminate between the two sugars before the scare.

5105. In respect to glucose?—We had only two sorts, and we should know exactly how that was used.

5106. Was your glucose all bought from Bostock's?—None of it.

5107. Were your invert sugars from Bostock's?—A portion of the invert sugar was obtained from Bostock's.

No knowledge of which brew is on sale at publicans. 5108. In the case of your tied houses, do you always know what brews are on the premises at any given time?—No; we should not know unless we went to them.

5109. You would know when it went to them, but you would not know when it was all consumed?—No, I think not, without visiting the house.

5110. (Mr. Cosmo Bonsor.) You keep a record of the gyles you send to each house. Do you know the particular brewing that you deliver to each house?—No.

5111. Do not you number your barrels?—Yes; but we have no record that such and such a date went to such and such a house; the date of the brewing would be on the cask.

5112. You have nothing in your books to show it?—No.

5113. You would have to go to the house to see?—Yes.

5114. Was it in the public papers that you first saw information to the effect that there was an epidemic?—We first heard of it when Mr. Groves telephoned to us and asked us if we had heard anything about it. We had not, and he asked if we had had any sickness but we had not had any sickness at all on the premises.

5115. When you first heard of it, arsenic was not named?—No.

Examination of brewers' samples by a analyst. 5116. Did you first see it in the papers that the epidemic was alleged to be due to arsenic?—Yes. It was attributed, I think, to the hops, to the sulphur used in drying the hops.

5117. Did you take any steps when you heard that

5091. At once?—Almost at once. We keep the beers in one store where we had a considerable quantity of beer at Bolton for a few weeks whilst we were carrying on correspondence with the Inland Revenue asking them to allow us to treat that as a portion of our brewery, inasmuch as it had never been invoiced out to customers, but they ultimately declined absolutely.

5092. You did not obtain a rebate?—No, and as nothing else was to be done we poured it down the drain.

5093. You have stores at Liverpool, have not you?—No.

5094. As far as you know there was no delay at Liverpool in destroying your beer on account of the Excise?—No, I have not heard there was any.

arsenic was suspected?—Yes; we went to the city analyst, Mr. Estcourt, and we then sent him samples.

5118. And you had a consultation with him?—Yes.

5119. And arranged to send him samples of beer on Monday after Saturday the 24th?—Yes.

5120. On Monday the 26th you again saw Mr. Estcourt?—Yes.

5121. And discussed the various theories which had been suggested?—Yes.

5122. Did you take him samples?—Yes.

5123. The samples which you gave the analyst had been brewed with Bostock's sugar?—Two of them had.

5124. On Wednesday, the 28th, you received Mr. Estcourt's report?—Yes.

5125. And that was to the effect that they were what?—That they were quite free from arsenic.

5126. All the samples?—Yes.

5127. On Thursday, the 29th, you attended a meeting of brewers of Manchester and district, when Mr. Gordon Salamon and Dr. Luff were present, and made statements?—Yes, to the effect that arsenic had been found in Bostock's sugars.

5128. You then learnt for the first time that the arsenic had been traced to the sugars supplied by Bostock?—Yes.

5129. That same evening you sent out three special travellers to withdraw certain beers which contained Bostock's sugars?—Yes.

5130. All the beers that contained Bostock's sugars?—Beers which contained a larger proportion than was usual of Bostock's sugars.

5131. And at the same time you summoned your travellers to meet at the brewery on the following morning?—Yes.

5132. And instructed your travellers to withdraw all beers of which you had any doubt?—Yes.

5133. (Mr. Cosmo Bonsor.) Did you destroy a large quantity of beer?—1,389 barrels.

5134. That was beer on your premises?—Part of it on our premises.

5135. Did you get a drawback on it?—On some of it.

5136. Did you claim it on the whole?—No. We were told it was no good claiming it on the whole. We claimed on that which had never left the premises.

5137. Who were you told by that it was no good?—By the Excise.

5138. By the Excise officers?—Yes we wrote also to Somerset House.

5139. Did you write individually, or was it the Brewers' Association that wrote?—We wrote.

5140. Could you put in the answer?—Not in the exact words, but it was to the effect that the local supervisor would witness the destruction of condemned beer which had never left our brewery premises. But no promise was given whether repayment would be allowed on such beer.

5141. Could you let Dr. Buchanan have a copy of the answer?—Certainly.

5142. I understand that the beer was kept hanging about for a certain time?—Yes.

5143. I do not know whether on your premises, but certainly in some places the beer was not destroyed as quickly as it might be, owing to the doubt as to whether

Mr. H. Blundell.
29 Mar.

Mr. G. E. Cowell.

Destroyed of incalculable beer.

Relate duty.

Mr. Coucell. the Inland Revenue were going to pay the drawback or not?—That was to some extent so in our case. We had a disused brewery; the vessels were all going to be pulled down, so that we put it there until we received a definite answer from the Excise that they could not allow rebate on it.

5144. Do you do much in the way of priming?—No, very little.

5145. You do not prime to the extent of what is allowed by the Excise?—Not perhaps 20 per cent. of what is allowed by the Excise.

5146. Do you prime with Bostock's invert sugar?—Yes.

5147. That was mainly how Bostock's invert sugar was used perhaps?—Yes, mainly.

5148. (Dr. Whitelegge.) Do you give guarantees with the beer you send out?—We have done so until recently, but we have discontinued it.

5149. Altogether?—Yes.

5150. You do not give any general or specific guarantee?—We have not done so.

5151. (Chairman.) Can you give us information as to the dates of the destruction of the beer?—The beer was

destroyed as follows:—180 barrels on December 5th, at the brewery, in the presence of the Excise officer; 1,062 barrels between December 11th to 26th, at the brewery, witnessed by responsible officials; 50 barrels on January 8th, at the brewery, in the presence of the Excise officer; and 97 at various country houses in the presence of our agents.

5152. Have you had summonses against any of your tenants?—Summonses have been taken out against six retailers of our beer; one has been fined, and the others have been adjourned pending the appeal from Mr. Headlam's decision.

5153. Have you taken precautions to test the beer you are now sending out?—Acting on the report of the committee of the Manchester Brewers' Association, dated 1st December, we have since that date sent no beer out that has not been tested and passed by Dr. Miller, the analyst appointed by the association. We have now received a notice from the Medical Officer of Health at Stockport that a sample of our beer, taken from one of our houses on the 26th February, contained 1.50th of a grain of arsenic per gallon. I should explain that we have two breweries, one at Newton Heath and the other at Oldham. None of Bostock's sugars were used during the period in question (between June and November 23rd, 1900) at our Oldham brewery.

Mr. G. E. Coucell.
29 Mar. 1901.

Beer now tested for arsenic before issue.

TENTH DAY.

AT THE TOWN HALL, MANCHESTER.

Saturday, 30th March, 1901.

PRESENT:

The Right Hon. LORD KELVIN (Chairman)

SIR WILLIAM CHURCH.

MR. COSMO BONSOR.

DR. WHITELEGGE.

DR. BUCHANAN, Secretary.

MR. SIGMUND STEIN, called; and Examined.

5154. (Chairman.) You are a graduate of the Imperial Royal Polytechnicum in Vienna, I believe?—Yes.

5155. You have had nearly 20 years' experience as an analytical and consulting chemist to sugar manufacturers?—Yes, I have; and I have been for the last ten years technical manager to Messrs. Crossfield, Barrow, and Co., sugar refiners, Liverpool, and am now acting for the same firm as scientific adviser.

5156. You also hold several other positions, do you not?—I am also consulting chemist and technical adviser to several sugar factories abroad. I am a member of the Society of Sugar Technologists, a German society having members all over the world, of the Society of Austrian Chemists, and of the Society of Chemical Industry.

5157. You have been also engaged in a great deal of investigation work, have you not?—I have been engaged in a great deal of technical investigation in reference to the sugar industry, have written many articles in various scientific journals, and am scientific correspondent of nearly all existing sugar journals. I have acted as arbitrator in disputes regarding sugar, and have been repeatedly called before courts as expert.

5158. Have you considered the risk of arsenical poisoning by means of sugars?—Yes. Poisoning by arsenic through the medium of sugar may occur even in sugar refineries. It is a known fact, and a matter of elementary knowledge, that commercial sulphuric acid contains arsenic in different proportions. If such commercial sulphuric acid containing arsenic is used in a sugar refinery, poisoning may occur. In the production of crystallised sugar sulphuric acid is not used. It is, however, used in the production of so-called "golden syrup," "table syrup," or treacle. Golden syrup is

made by clarifying molasses by means of animal charcoal. Molasses, the last residue from sugar refining, does not crystallise at the time it is produced. After a certain time, however, molasses commences to crystallise. This tendency to crystallisation is a great drawback in the production of golden syrup from molasses. To prevent the crystallisation of the golden syrup, the molasses are treated with a small quantity of sulphuric acid, to change or invert the saccharose into dextrose and levulose. If the inversion is properly done the golden syrup will never crystallise. For the purpose of the conversion of the molasses, the latter are dissolved to a density of about 25° Beaumé in a copper vessel provided with a mechanical stirrer, and furnished with a system of narrow steam pipes through which low pressure steam is supplied. The molasses solution is kept for about 15 minutes at a temperature of 190° Fahr. About this time diluted sulphuric acid is added. The dilution of the sulphuric acid is effected in a lead vessel, which has a graduated scale inside to determine the quantity of the acid. The quantity of acid used depends upon the purity of the sugar and of its saline contents, and varies from .03 to 1.5 per cent. of concentrated sulphuric acid to 100 parts of molasses. Professor Wohl has studied this question, and I refer to his investigation in an Appendix. After the sulphuric acid is added to the molasses solution, and the latter has been tested, the solution is neutralised with carbonate of lime. By this addition a precipitate of sulphate of lime is formed, which is filtered off through filter bags or filter presses. The filtrate running off from the filter bags or filter presses is then sent over animal charcoal to be decolorised as much as possible, the animal charcoal retaining the impurities, and the liquor running off from it is boiled in a vacuum pan to 42° Beaumé. If the sulphuric acid is used in a

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perfectly pure state, and is perfectly free from arsenic, no danger can occur. If, however, it contains arsenic, the latter is sure to go into the golden syrup.

5159. Will all the arsenic go into the golden syrup or only a portion of it?—All the arsenic goes into the golden syrup. The carbonate of lime used in the copper pan will not precipitate the arsenic, and the charcoal retains only a very small quantity of it, so that the bulk of the arsenic passes into the golden syrup. How dangerous the smallest quantity of arsenic in such syrup may be is clear from the fact that golden syrup is taken as food by children, and is also used in pastry making. I think that attention should be paid to this subject.

Inversion of
sugar; pro-
portion of
acid needed.

5159a. (Chairman.) You mention in your précis Professor Wohl's patent?—Professor A. Wohl and Dr. A. Kollrepp took out a patent in Germany (No. 57368, of 11th July, 1889), regarding the inversion of sugar. Wohl and Kollrepp say that it exists for every acid a very weak concentration by which, on heating from 80° to 95° Centigrade, sugar is in from half an hour to an hour inverted to the fourfold quantity of the diluted acid used, and without decomposition and dark coloration of the resulting invert sugar.

Professor A. Wohl calculated that for an 80 per cent. sugar solution the necessary percentage of acid calculated on sugar is:—

0.01 to 0.02	of Hydrochloric acid.
0.02 „ 0.03	„ Bromic Acid.
0.02 „ 0.03	„ Nitric Acid.
0.03 „ 0.05	„ Sulphuric Acid.
0.05 „ 0.20	„ Fluoric Acid.
0.15 „ 0.25	„ Phosphoric Acid.
0.20 „ 0.40	„ Sulphurous Acid.

5160. The table given by you shows .03 to .05 per cwt. of sulphuric acid, whereas you told us .03 to 1.5?—The table refers to the investigation of Professor Wohl, as given in his patent. He says that .05 is a minimum and .03 is a maximum of sulphuric acid as used according to his process and investigations, but I have found that these figures of Wohl are not quite according to my experience. You cannot invert properly with sulphuric acid at .05. I have myself used over 1 per cent. of sulphuric acid for conversion in Liverpool.

5161. You say 1.5 of concentrated sulphuric acid to 100 parts of molasses; did you put in diluted sulphuric acid?—Yes.

5162. What would be the strength of the solution of sulphuric acid?—10 per cent. SO_3 , or H_2SO_4 , in a hundred parts of water.

5163. Then the sulphuric acid and water added gives 1.5 per cent. of concentrated sulphuric acid as a whole?—Yes; on the weight of molasses.

5164. Are you advising that it should be so done, or are you doing it yourself?—I am doing this myself.

5165. A little explanation is wanted, because it might be supposed that 1.5 per cent. of strong acid was added to the molasses, but that is not so?—That is not so. The sulphuric acid must be diluted. We cannot put sulphuric acid in a concentrated state into sugar solution. We make a diluted solution of sulphuric acid of 10 parts in 100, the ordinary diluted sulphuric acid used in laboratories of works for conversion. This diluted sulphuric acid is added in such a way that 1.5 concentrated sulphuric acid corresponds with 100 parts of the weight of molasses.

5166. Is it 1.5 per cent. added to the molasses or to the molasses and water?—The molasses.

5167. So that besides what is stated here, there is 15 per cent. of water?—That is so.

5168. Could you tell us any of the works in which this is actually done?—I have done it in the sugar refineries of Crossfield, Barrow and Co., two years ago.

5169. Have you continued to do it commercially ever since?—No. We have meanwhile stopped our refinery. We have not done any for the last fifteen months.

5170. Was this process carried out commercially for some months?—It was carried out for a few months.

5171. I think you have something to say about the addition of glucose to treacle?—Yes. It is the custom of this country to use glucose for mixing with refiners' treacle to make the latter uncrystallisable, and thus to avoid the use of sulphuric or other mineral acid in the

manner above mentioned. I pass over the legal question whether the mixing of refiners' treacle with glucose should be allowed or not, and will only say that if the glucose used for mixing golden syrup is impure and contains arsenic, the same danger may be present as I have already mentioned above in regard to the use of sulphuric acid. How great this danger is may be judged from the fact that in the recent prosecutions before many police courts in Great Britain it has been shown that from 30 to 80 per cent. of glucose are mixed with 70 to 20 per cent. of treacle. That glucose may contain arsenic was proved by the lamentable case which occurred in a Liverpool glucose factory. In Schlossberger's Handbook of Organic Chemistry, p. 111, there will be found under the heading of glucose the following passage:—“Very often the glucose of commerce contains sulphate of lime or sulphuric acid. Glucose, by means of this acid, often contains poisonous metallic oxides. Payen has recommended, in consequence of this, the application of diastase for the transformation of the starch into sugar.” This book was written in the year 1857, nearly half a century ago. I need not quote the reference to arsenic in glucose in Blyth's standard work on Food Analysis.

5172. What is the date of Blyth's work?—1896 or 1897.

5173. (Sir William Church.) That is the last edition. Blyth's work was published, I think, in 1886?—Yes, but I think the last edition is 1896.

5174. But it is mentioned in the older edition, is it not?—I have only seen the new edition.

5175. (Chairman.) Do you know anything of American glucose?—Yes. I analysed commercially a great many hundred samples of American glucose, because we as refiners have been great importers of American glucose ourselves. We used this glucose for the special purpose I mentioned—for mixing with our treacle. We got large orders from abroad, especially from Switzerland, and it was prescribed by these firms in Switzerland how much glucose they wished put in the molasses. It was nothing else than American glucose mixed with a small percentage of English cane sugar treacle. They sold it in Switzerland as a kind of honey. I came to the conclusion that they used it as honey from the fact that they prescribed an abnormal density, a density which nobody in England would buy—45° Beaumé—practically a half solid mass. We had to boil it so much that it would not run out from the vat or from the mixing cistern.

5176. Is it used as honey?—So I have been informed.

5177. (Sir William Church.) Or rather it is used to mix with honey?—I think it will be mixed or used as an artificial honey by adding some essential flavours to it. As you probably know, there are so-called honey flavours on the market, which will give to sugar stuff a honey flavour.

5178. (Chairman.) Have you examined the American glucose and tested it to see whether it is free from arsenic?—I have analysed several glucoses, but I cannot remember having analysed American glucose. I have analysed English glucoses to see what was being done in this country, as I was specially interested in the glucose trade. I have made a few tests, and have found in English glucose copper and arsenic. I do not know the date of their origin.

5179. In every specimen?—In a few cases. I tried for the arsenic with Marsh's test, and with this delicate test there was only a trace. It was there distinctly arsenic. I wrote a letter to the paper, but, of course, I could not cause any excitement by mentioning that it was arsenic. I drew attention to the impurity of the glucose of commerce.

5180. Have you tested any of the Bostock glucose?—No.

5181. Of all the specimens you tested only a few contained arsenic?—Only a few.

5182. And the quantity that those few contained was very small?—Yes.

5183. Barely perceptible by the Marsh test?—Barely perceptible.

5184. Did your Swiss order specify American glucose?—No, only glucose.

5185. Did your Swiss order say that it was to be free from impurities?—No; they left it to us. They left the whole blame and responsibility to us. The buyer came from Switzerland and saw me at the works. I had a long talk with him about how the thing was

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Glucose in
treacle.

In honey.

Arsenic in
non-Bostock
glucose.

Mr. done and what kind of glucose was used, where we got the glucose from, and so on.

Mar. 1901. 5186. What do you say with regard to the purity of sulphuric acid?—It is necessary to draw greatest attention to sulphuric acid. The sulphuric acid used should always be a purified acid from whatever source it may be made, whether from brimstone or from sulphur recovered in alkali works, or from the spent oxide of gas works, or from pyrites. It is very often said that brimstone acid is perfectly free from arsenic. Professor Dr. Ferdinand Fischer, of Göttingen, the highest authority on chemical technology in the world, says in his handbook (1893), page 396:—"The quantity of arsenic in sulphuric acid made from raw sulphur is mostly small, but it is larger if it is made from pyrites or blends." I have since studied the question further, and find references about the impurity and the contamination of brimstone acid with arsenic in other works. Very often arsenic was found in so-called pure concentrated sulphuric acid for laboratory use. I pointed out the existence of bad glucose in my letter to the "Liverpool Daily Post," dated 25th March, 1898. I have analysed many samples of glucose, and found in a qualitative analysis traces of arsenic. I am sure these glucoses have been of English manufacture, as I analysed at the time only English glucoses. That they were English glucoses I remember by the fact that I took a special interest in the glucose manufacture in England at that time, 1897 or 1898. I have read a statement in the papers that sulphuric acid was used in sugar refineries for washing charcoal. I think this statement was made at a public inquiry in Liverpool. This is not correct. As is well known, charcoal contains lime, and if sulphuric acid were used, sulphate of lime would be formed, which would close the pores of the animal charcoal, and would make it useless for decolorisation. A sugar refinery is a manufactory where food stuffs are made. It is necessary that there should be proper chemical control in every such factory. The chemist must analyse every raw product coming into the factory, likewise every finished product, and any materials used in the manufacture, to ascertain their purity. If a poison is used, or an article which may contain a poison, every lot of this material must be analysed to ascertain its freedom from the poison. If in a sugar factory poisonous materials are used, every lot of sugar turned out ought to be analysed for poison. The samples must not be taken from a big bulk, but from small quantities, as it is impossible to get an average analysis from a large quantity of sugar. From time to time samples of sugars should also be sent to a public analyst, so as to have the analysis of the factory chemist checked. All such analyses should be recorded in a book. Poisons are often used in sugar-works, say, sugar-works in Germany, France—I will not say Austria. So, for instance, the baryta process raised the suspicion of the Government, the health authorities, and of the public analysts.

5187. Is that in Germany?—Yes; there are many other processes where poisons are used, for instance, lead. In desucration works it is often the case that sugar is made from molasses by the lead process. This process is not so much used now as it was 10 or 15 years ago. In mentioning the Baryta process I recall to mind an incident. A sanitary inspector from the Berlin office came to the factory, and said, "If we allow you to use this Baryta process, if the sugars turned out by the process are free from Barium, well and good; but if the smallest trace of baryta is found in your sugar we shall close your factory." They watched the sugars, and the manufacturers, to make sure, did not depend on their own chemist, but sent the material for analysis to a Government and public chemist, practically throwing the responsibility from themselves on to the Government laboratory, thus making themselves safe against prosecution. Very often phosphoric acid is used in sugar factories for the purpose of decolorising and clearing the juice and also from clearing the sugar-juice from lime. I have frequently found commercial phosphoric acid containing arsenic. By the use of phosphoric acid containing arsenic, the latter can also pass into the sugar. Phosphoric acid is also used in the preparation of golden syrup in a similar way to sulphuric acid, and in several of the beet sugar factories. If this phosphoric acid contains arsenic, beet sugar also may be contaminated with arsenic. I have myself a patent for the refining of sugar without charcoal, entirely with chemicals. The principal agent is peroxide of hydrogen. I was the first

to introduce, 12 or 13 years ago, peroxide of hydrogen into sugar refineries, and since that time several other patents have been taken out by Frenchmen and Germans. In this process I used phosphoric acid. Phosphoric acid is a great decoloriser, and it is also used for precipitation of the last traces of lime. This phosphoric acid and phosphates are used in a great many cane sugar factories, raw sugar factories, and refineries, both in the British Colonies and foreign colonies.

5188. How do you get your phosphoric acid free from arsenic?—The danger of phosphoric acid containing arsenic comes from the sulphuric acid solely. Phosphoric acid is made from phosphates or bone ash—from natural phosphates, but mostly from bone ash.

5189. Is there a liability for natural phosphates to contain arsenic?—I have never analysed natural phosphates.

5190. Does bone ash sometimes contain arsenic?—Bone ash not, but for making phosphoric acid spent charcoal is used, charcoal which has been turned out from refineries because it has lost its decolorising power. This charcoal is burnt to burn off the organic matter, and the ash is used for making phosphoric acid containing phosphates of lime. If the charcoal contained arsenic I am not sure whether some might not be found in the ash.

5191. In every case you test the phosphates for arsenic?—The phosphoric acid must be tested for arsenic, and I do so repeatedly.

5192. Did you do that before the recent epidemic?—Yes.

5193. Several years ago?—Five or six years ago.

5194. You tested the phosphate for arsenic?—Yes.

5195. Did you frequently find arsenic in your tests?—I found it in two cases.

5196. Out of a large number?—Not a large number. I should say I only found traces. The people I bought the phosphoric acid from did know that I used it for sugar refining. I bought it on the Continent and I bought it from Scotch manufacturers. They have been always free from arsenic. I found arsenic in two or three consignments from German manufacturers, one of the largest manufacturers in Germany, in spite of the fact that I told them I wanted it for sugar refining, and free from arsenic. As there were only very small traces I used them.

5197. Is the use of sulphuric acid in molasses a general usage, or is it only in your own factory?—That brings me to a point which I wish to mention. In this acid in country, in most households golden syrup is used, making There is a big trade in golden syrup, and a great number of factories make a speciality of it. They make more golden syrup than sugar. They sell so much golden syrup that the residue which they would get from the refinery is not sufficient to cover the demand, and the price they get for this golden syrup is so profitable that they make it direct from sugar. They take raw sugar or half refined sugar—raw sugar may be white, but is sugar not purified in a sugar refinery, like French No. 3 crystal—and use thousands and thousands of tons every year for making golden syrup only, sugar transformed and inverted into golden syrup.

5198. Inverted by sulphuric acid?—Yes. That is done to-day, I should say, at the rate of ten to fifteen thousand tons per annum, or it may be twice or three times as much as that.

5199. Is there any way of converting crystallised sugar into what would be suitable for golden syrup except by sulphuric acid?—No. I have tried myself with sulphuric acid and with hydrochloric acid, but the great disadvantages I have found with hydrochloric acid is that you have to neutralise the acid, which can only be done with carbonate of soda, which leaves chloride of sodium in solution. I put very little hydrochloric acid in, keeping to the limits of Wohl, but it was unsatisfactory. When I used a very small quantity of hydrochloric acid I did not neutralise; I left the acid in the syrup. I dissolved the sugar to a certain density, and put a certain quantity of hydrochloric acid in. The sugar was converted, and without any neutralisation I filtered the acid solution off mechanically, through filter bags, and sent it over animal charcoal. It left the whole thing acid. I evaporated in a vacuum pan and boiled it down to a pouring consistency. The syrup was out was very slightly acid.

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M. S. Stein. 5200. Did the hydrochloric acid go away in the evaporation?—Yes. This stood very well for two or three months, and I was highly pleased with my invention. I tried mixing the treacle or golden syrup with glucose, but after two or three months, especially in summer time, when the syrup was distributed amongst grocers and put into warm places or exposed to the sun, it crystallised. I had put too little hydrochloric acid in. I did not put it as stated by Hertzfeld, one to one. Hertzfeld's investigation showed that inversion should be done in such a way that saccharose should be in a certain proportion to dextrose and levulose. It was one to one, and I did not go as far as that.

5201. And the result was that the golden syrup crystallised?—It crystallised to a perfectly solid mass, and we got the syrup back in cardboard boxes instead of the barrels it was sent out in.

5202. Was not the syrup objected to on account of the acid itself?—No, it was only slightly acid. I tested for hydrochloric acid, but it was only very slight. The slightly acid reaction of the golden syrup made the syrup more palatable; it had not the dead sweet taste of the golden syrup. In speaking about the taste of golden syrup, I may say that the more inversion takes place and invert sugar is formed the more agreeable is the golden syrup. Saccharose has a very nasty taste, whereas invert sugar on account of the levulose has a more pleasant taste.

Most glucose arsenic-free.

5203. (Mr. Cosmo Bonsor.) Is there any reason why arsenic should not be kept entirely out of glucose?—There is no reason. 99 per cent. of the glucoses made are free from arsenic.

5204. If there was a legal penalty for arsenic in glucose the manufacturers could keep it out without difficulty?—Certainly. I have heard it stated that nearly all glucoses contain arsenic, but I should reverse that and say from my long experience on the Continent and in this country in glucose factories that arsenic in glucose is the exception, and the rule is that glucoses do not contain arsenic.

Prof. S. Delépine.

Quantitative tests for arsenic by Reinsch method

in beer: quantity of beer used.

No arsenic found in Munich beer.

5208. (Chairman.) We took part of your evidence yesterday, and you were going to hand us in the name of the brewery from whom you got a sample of beer marked "Private" in Table I?—Yes. (The name of the brewery was given to the Commissioners.) Might I add a few words as to the manner in which we ascertained that the test we used was accurate? Firstly, we compared our results with those obtained by Professor Dixon, who had kindly undertaken to analyse portions of three of our samples (beer, glucose, and sulphuric acid) by the usual methods. On several occasions the same specimens were examined with perfectly identical results. Secondly, we had sent to us on two occasions samples which were supposed to be of different origin, and we found by testing that the quantity of arsenic found was exactly the same. On further enquiry it was discovered that two samples of the same beer had been sent to us.

5209. (Sir W. Church.) Certain of the beers that you tested I see marked in this table (Appendix, No. 12, p. 246, Table I), with a nought with a query; N, for example, is so marked, and the Munich beers have a nought without a query. That means that there was no trace of arsenic in them?—So far as we could ascertain there was no trace. In the case where a nought has been entered, we have not only tested the usual quantities of beer, but have gone up to one litre of beer, which is 10 times as much beer as we have used in most of the other cases. The quantities are all put in the table.

5210. But in these beers you used a larger quantity?—Yes, a larger and larger quantity until we found that test after test would reveal absolutely nothing. That dark lager beer which I have tested has been used as a diluting fluid for a great number of materials in order to have a substratum always of the same composition, not water. This beer has been tested, I should think, 50 times as a matter of control in the course of the investigation, and we have never been able to obtain a sublimate of arsenious acid from it. We have not used the light lager beer in the same way, because although we could not get any sublimate from it there was always a slight darkening of the copper.

5211. (Mr. Cosmo Bonsor.) Whose beer was it?—I could not say. The actual name of the brewer was im-

5205. Do you say the same with regard to invert sugar?—Yes.

5206-7. (Chairman.) You wish to put in a letter that you wrote to the *Liverpool Daily Post*?—This is a copy of the letter which I wrote:—

BREWING SUGAR AND PURE BEER.

To the Editor of the *Liverpool Daily Post*.

SIR,—Your leader in to-day's issue very clearly hits the point on the beer question. In mentioning the experiments made with brewing sugars on cats, you quoted the evidence of Dr. Schidrowitz and Dr. Tunnicliffe, "that brewing sugar residues produced vomiting, whereas the residues of all-malt beers were quite normal, no symptoms of any kind having been observed."

There is a great difference in the character of brewing sugars. I have analysed and investigated many samples as a private hobby, and have come to the conclusion that where brewing sugar is used it should be in certain proportions and of a certain analysis, which should be prescribed by an Act of Parliament.

The question is of such great importance to the general health that some restrictions and regulations should be made, such as is the case in the sale of manure and feeding stuffs, when the analysis must be given; and it should also be made imperative that the Excise authorities in breweries, the brewer himself, as well as the health authorities, should be informed of the full analysis of every substitute used in the brewing, especially the brewing sugar, and that such analyses should be stated on the invoice by the seller.

Yours, etc.,

SIGMUND STEIN.

214, Upper Parliament Street, March 25th, 1898.

Professor SHERIDAN DELÉPINE recalled.

material to me. I simply desired to actually get a sample of Austrian beer.

5212. Are you quite sure it came from Vienna, because there is beer in England sold under a foreign name?—It was imported by Moellers here, who are large importers, and they guaranteed that the beer came from Vienna, and gave me the date of the consignment. I have also examined some samples of English beer, which showed no distinct evidence of the presence of arsenic.

5213. (Sir W. Church.) Was this beer you referred to an English beer?—Yes, and it was practically free from arsenic. We have tested several samples of English beer, especially from the South, which contained only very slight and unimportant traces of arsenic. They have not been included in the table, because this report only contains what was done for the Salford inquiry. All the other experiments or analyses have been carried out at my own expense, and were quite unofficial.

5214. Had you introduced into this table your experience of beer generally, southern beer as well as local beers, there would have been a larger number to which you would have placed a nought, or a nought with a query?—Yes, nought with a query. In some of them the traces were so small that they were immaterial.

5215. (Chairman.) How did you apply your method to materials other than beer?—The soluble substances were dissolved in 100 cc.'s or 200 cc.'s of dilute pure hydrochloric acid (1 part of acid to 5 parts of water). Instead of water, arsenic-free beer has been used, whenever possible, in order to render results more comparable. Some experiments seemed to show that the precipitation of arsenic took place more readily from solutions of arsenious acid in beer than from solutions in pure water. Insoluble substances such as malt and hops were suspended in a sufficient amount of dilute hydrochloric acid (1 to 5), from 100 to 200 cc.'s of fluid were used. These substances were usually macerated for several hours before the tests was applied. Sulphuric acid was neutralized with pure ammonia before being tested.

5216. Can you summarise your results?—Yes. A summary of the results of analyses of various products

P. S. D.

or in English beers.

Prof. 12, Tables I. to IX.). These nine tables relate to the following materials: Beer, malt, hops, glucose, invert sugar, fuel, raw material, of brewing sugars, sulphuric acid, and other materials used in glucose making, and, lastly, an estimation of arsenic in a particular sample of urine of a beer drinker. In each instance I have given (a) the amount of arsenic estimated as arsenious acid in 10 million parts of material analysed in each case; (b) the quantity of the poison, estimated in grains per gallon in the case of beer, and per pound in the case of other substances; (c) the largest and the smallest amount of material analysed; (d) finally, in the case of brewing material I have calculated in each case the maximum amount of arsenic which each article might introduce into a gallon of beer.

titative 5217. What is your opinion of the exactness of the quantities obtained by your test?—These quantities are only approximate, but they are never in excess of the quantity which is present in the beer. This has been ascertained by making solutions of known strength and trying to recover the arsenic present in these solutions; and it was always found that we could estimate with close approximation the amount we put in. The differences which can be estimated by the test I have devised are much under one-thousandth of a grain, so that although the method is only approximate it is a very accurate method compared to many other methods of analysis.

5218. Your quantitative result is founded on a comparison of standard specimens?—Yes, it is a purely empirical method, but carried out with reasonable care, it yields results which can be relied upon, and which are at least as correct as those of good volumetric methods of analysis usually are.

5219. Your standard specimens are kept from week to week; do they alter at all with time?—They have not altered yet during this investigation, but we have prepared new sublimates from standard solutions, and they corresponded exactly to our original standards, so that up to now our first standards have proved to be quite reliable.

5220. Do your standards show the difference between 1-20 of a grain per gallon and 1-25 of a grain per gallon?—No. We have not attempted to estimate by direct comparison such small differences as that. We have made a number of sublimates, and we have selected those sublimates which were quite distinct from each other both to the naked eye and under the microscope. We found the most convenient for use—those made with 1-100 milligrams in 100 cc., or 1 in 10 millions; 1-20 of a milligram in 100 cc., or 5 in 10 millions; and 1-10 of a milligram in 100 cc., or one part in a million (1 part in 10,000,000 corresponds to 1-143 grain, say 1-140 grain per gallon). With these three standards it is always possible to say whether a sample contains more arsenic than one of the standards, and less than the next standard above it. The differences are so marked that there is no difficulty in estimating the place of the sample examined between two standards. The differences are sufficiently small to make the estimation accurate enough for all practical purposes.

5221. We have had evidence as to one set of specimens of beer in which different analysts found different results. One analyst found 1-40 of a grain per gallon, the Somerset House authorities found 1-30 of a grain per gallon, another analyst found 1-15 of a grain per gallon, and another one found 1-5 of a grain per gallon. Would your test distinguish between 1-20 of a grain per gallon and 1-30 of a grain per gallon?—Yes, by taking into account the amount of beer analysed and that of sublimate obtained—I have explained in answer to a previous question (4929) that when an accurate estimation is wanted, several tests are applied in succession. The first test, for which 100 cc.'s of beer are used, indicates roughly the amount of arsenic. The second test is made with a quantity of beer which should contain, according to the indications of the first test, an amount of arsenic corresponding to one of the standards. By this second test a further approximation is obtained, which is generally sufficient for practical purposes. At this stage the approximation is generally within 1-70 grain per gallon. By a third test the margin of error can be reduced to 1-140 grain per gallon. It is, therefore quite easy to distinguish between 1-20 and 1-30 grain per gallon.

5222. Would you expect a public analyst to be able to distinguish decidedly between 1-20th of a grain per gallon and 1-30th of a grain per gallon?—He should be able to do so easily.

4576.

5223. And a public analyst, with time given to him and the circumstances considered, ought certainly to distinguish between 1-20th and 1-30th of a grain per gallon?—Yes. It would take him between two and three hours to do that. If he started originally with a quantity of beer which gave a sublimate exactly corresponding with one of his standards by a single estimation, taking about an hour, he would be able to give an exact amount. If he did not happen to hit upon the exact quantity of beer necessary to obtain a sublimate corresponding to a definite quantity, then he would have to repeat the test a second time, and sometimes a third time, this would take him two or three hours according to the number of tests he had to apply.

5224. The differences I referred to were given in evidence in a law case, somewhat to prove that able men, public analysts, found it a very difficult thing to make sure of?—I think a great part of the difficulty is due to there being no fixed method recognised for the estimation of arsenic. It is well known that the various rapid methods of analysis in common use, even when carried out very carefully, give different results. The estimation of extremely minute quantities of arsenic is always a matter of very great difficulty, and the results of different observers who use different methods in the estimation of very small quantities can seldom be compared.

5225. Would you think that such large discrepancies as those I mentioned, 1-40th of a grain per gallon by one, 1-30th by another, 1-15th by another, and 1-5th by another should occur?—I certainly would take the Somerset House authority as being one upon which the magistrates should rely.

5226. You would not think the magistrates were entitled to dismiss the case because four analysts gave four different results?—Certainly not. I think it would be a case rather for postponing judgment than for dismissing.

5227. (Sir William Church.) What are your reasons for thinking that in some cases precipitation of arsenic takes place more readily from solutions of arsenious acid in beer than from pure water?—On three different occasions we made arsenical solutions of the same strength in pure water and in pure beer, and we found that the sublimates obtained from the solutions of arsenic in water were smaller than the sublimates obtained from the corresponding solution of arsenic in beer. The three sets of analyses gave very nearly the same results, and it seemed to me that the presence of organic matter in beer accelerated the precipitation of arsenic on the copper. It was quite unexpected. We thought that the reverse would occur. But these are the facts we obtained, and they want to be investigated very much more carefully, because they may be of some importance.

5228. So far as those investigations go, it would rather suggest that one of the difficulties which has been placed before us by other chemists is not likely to be true, and that is, that it is possible that arsenic in combination with organic radicals would not be so easily detectable by the modified Reinsch test as when it was not in combination with organic radicals?—That is exactly the point I wanted to test, and I found there was no evidence whatever that arsenic was more easily precipitated from watery solution than from a solution in beer. On the contrary, arsenic present in beer was very much more easily recovered than arsenic in water.

5229. So far as your present investigations go, they would rather tend to show there is no likelihood of arsenic escaping observation because of its being in combination with organic substances?—There is not the slightest evidence of that being the case. I have made a special investigation of that point, which I propose to refer to afterwards. Another point about which some difficulty arose was the state in which the arsenic was in beer—whether it was suspended as a precipitate, or whether it was a soluble compound, such as an arsenite or arsenious acid pure and simple. In order to ascertain whether part of the arsenic present in the glucose or in the wort was in the form of a precipitate, or whether, as I had supposed, all the arsenic was in solution, the following experiment was made. To 100 cc. of slightly arsenical glucose was added. After a time a portion of the turbid fluid was filtered through porcelain. 10 c.c. of the unfiltered solution, and 10 c.c. of the clear filtered were then tested in the usual way, and it was found impossible to

Prof. S. Delépine,
30 Mar. 1901;

Arsernic recovered more easily from beer than from water with Reisch test.

Question of combination of arsenic with organic matter of beer.

Prof.
S. Delépine.
30 Mar. 1901.

discover any appreciable difference in the amount of arsenic present in the filtered and the unfiltered fluid. The arsenic was, therefore, in the form of a soluble compound, both in the glucose and in the wort probably some arsenite, for other evidence shows that the presence of arsenic acid and arsenates is improbable. This additional test supports the view that all the arsenic in beer is in the form of arsenious acid, or some soluble arsenite. These are the two samples. (*Samples shown.*) The filtered sample yielded exactly the same amount of arsenic as the unfiltered sample.

5230. (*Dr. Whitelegge.*) The experiment you have described would not show whether the arsenic was in organic combination or not, would it?—No, it does not show that; it simply shows that one has to deal with a soluble compound which is equally diffused throughout the whole fluid, and the results of other tests are exactly the same as those obtained with solutions of arsenious acid, or arsenites. Arsenious acid and arsenites dissolved in beer gave the same reactions as did the incriminated beer. This experiment shows certainly that we had not to deal with a precipitate like sulphide of arsenic.

5231. You told Sir William Church that you thought the ready precipitation of arsenic from beer showed that the presence of organic matter possibly accelerated the deposit?—That is the impression which the results have given us.

5232. Would that extend to cases in which arsenic was in combination with organic matter? If, for example, you had cacodyle, or an organic compound of arsenic of that kind, would the arsenic be deposited on the copper?—I have not gone yet much into that part of the question, because cacodyle would give such a very bad smell to the beer that its presence would have been evident. I have tasted the samples of beer, and smelt them all, and found no evidence of it.

5233. I was thinking of the suggestion that the arsenic might be in combination with organic matter, not as cacodyle necessarily, but in some form, and I wanted to know if you could tell us whether if it were in that combination it would be deposited on the copper in Reinsch's test?—I am not certain it would. I cannot yet give the results of actual experiments. The other results showed it is not likely that arsenic was in the presence of arsines or other organic compounds, because all those which might reasonably be expected to occur in beer are generally much less poisonous than the compound which was actually present in the beer. The toxicity of the beer was exactly similar to that of a solution of arsenious acid or arsenites. This was proved by several experiments. A summary of some of the recent work upon the physiological action of arsines is given in E. Wortheimer's article on arsenic in Richet's *Dictionnaire de Physiologie*, 1895, p. 701.

5234. (*Chairman.*) It would be the same as that of an equal quantity of arsenic in Fowler's solution?—Yes, it behaved exactly like Fowler's solution.

Explanation
of accom-
panying
tables.

5235. On what basis do you calculate the maximum amount of arsenic that would be given by each ingredient to a gallon of beer?—This calculation has been made in the case of malt and hops on the supposition that the largest possible amount of material had been used in brewing, whilst in the case of malt substitutes, the average amount acknowledged to be used has been the basis of calculation. It will therefore be evident that in the case of malt the calculated amount of arsenic has been probably often over-estimated to the extent of over one-fifth of the number given, whilst in the case of malt substitutes there is a variable degree of under-estimation. I say one-fifth, because one-fifth at least of the malt is replaced by malt substitutes when brewing sugars are used.

5236. (*Sir William Church.*) That is to say, you have considered that a beer you have had to examine has only had 25 per cent. of glucose when it might have had 40?—Yes. We have taken the minimum which is recognised to be suitable for good brewing.

5237. Which would be about 25 per cent.?—About that. There is one part of solid substance to four parts of finished beer, and of that one part of solid substance a certain proportion which otherwise would be malt is replaced by glucose or invert sugar. I have based my calculations on the supposition that that quantity was about one-fifth.

5238. Is there no way by which in the finished product it could be discovered what quantity was added?

—I am not sure about that, but this question did not come within my line of work. I do not think it would be altogether impossible to find that out.

5239. (*Chairman.*) As regards the arsenic in Bostock's glucose and invert sugar, can you reckon what it may have been from your knowledge of the quantity of arsenic in the sulphuric acid used?—The amount of arsenic which passes from sulphuric acid into glucose or invert sugar can only be surmised, but supposing that the best flour be used, about 5 per cent. of sulphuric acid would be required to obtain the conversion of 1 lb. of that flour into 1 lb. of glucose. Supposing again that all the arsenic contained in the amount of sulphuric acid used to make 1 lb. of sugar was retained, each pound of sugar would, on the basis of the lowest estimate, contain at least five grains of arsenious acid. But as the mixture of sulphuric acid and newly-prepared glucose is submitted to various processes (neutralisation, passage through charcoal, and sometimes bleaching) before the sugar is ready for use, it is difficult to say how much of the arsenic remains in the glucose. The charcoal should abstract large proportions of arsenic. It must, however, be remembered that the charcoal obtained from the Bostock factory yielded both before and after reburning a large amount of arsenic; it is probable, therefore, that filtration through such charcoal could not have had a very beneficial effect. That this was the case is shown by the quantities of arsenic found in some of the samples of glucose, which, judging by their appearance, had been decolorised by charcoal. Pale glucose 23, Table IV., contained over four grains of arsenic to the pound. So that the charcoal used in that case cannot have done much in the way of removing arsenic. Although it is impossible to calculate with accuracy the actual amount of arsenic introduced into the sugars by sulphuric acid, it is clear that the acid contained more than enough to account for all the arsenic found in the brewing sugars. The flours were free from arsenic, and the sulphurous acid used for bleaching contained only a small amount of it. The following quotation taken from a letter I have received from Dr. Thorne, the chemical adviser to Messrs. Garton, Hill, and Co., shows that the amount of arsenic taken up by the glucose must be influenced to a certain extent by the nature of the starchy material employed. "Theoretically, pure dry starch should give 111 per cent. of dry glucose, and pure dry sugar 105 per cent. of dry invert sugar. But commercial starches contain from 10 to 20 per cent. of moisture and minute quantities of fibrous or cell matter, and commercial flour 10 to 20 per cent. of moisture and a varying but appreciable quantity of fibre. Raw sugars contain varying proportions of moisture and of foreign organic matters, removed during the conversion and purification. On the other hand, it is not practicable to prepare commercially either invert sugar or glucose in the dry state. Solid glucose and commercial invert each contain about 18 per cent. of moisture. In practice the quantities obtained are approximately as follows, varying, of course, slightly for different lots of material:—

100 tons starch yield 100 to 102 tons glucose.
100 tons sago flour yield 95 to 98 tons glucose.
100 tons tapioca yield 93 to 98 tons glucose.
100 tons raw sugar yield 105 to 108 tons glucose.

For the conversion of starch about 4 per cent. of sulphuric acid (70 per cent. acid of specific gravity 1·600) is required, for flour 5 to 6 per cent., and for sugars 1 to 2 per cent. These percentages are calculated on the weight of raw material." This information from Dr. Thorne shows that it is practically impossible to calculate accurately the amount of arsenic that will be retained, but that approximately this can be done tolerably well.

5240. (*Sir William Church.*) Do I understand that the charcoal Messrs. Bostock were using contained arsenic before it had been in the filters?—Yes, I understand that the charcoal is used over and over again.

5241. That I understand. But I want to know whether you examined any charcoal that they were using before it had been in the filters at all?—No. We examined what I suppose they would call new charcoal, which was really old charcoal re-burnt.

5242. But you did not examine the pure material in the first instance?—No. We had no chance of doing that.

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5243. (Chairman.) As regards arsenic in malt, I see from your table No. 2 that you found it to vary between nothing which was detectable by your test, and one-fifty-seventh of a grain per lb. approximately?—That is so.

5244. (Mr. Cosmo Bonsor.) If arsenic is excluded from sulphuric acid and from the fuel used for drying malt and hops, the beer would, in your opinion, be practically free from arsenic?—I think so. I think there would, as a rule, remain so very little arsenic in the beer that it would become practically free from injurious quantities of arsenic. One has to distinguish between the amount of arsenic which might possibly produce some mischief. The amount of arsenic which produced the outbreak was almost entirely due to the sulphuric acid. The amount of arsenic which is now thought, as a matter of speculation, a possible source of danger, must have been introduced by malt.

5245. From the fuel?—Yes.

5246. I say practically free, because of the query you placed with the nought. There may be the smallest possible trace, but they are free as far as circumstances admit?—Certainly.

5247. (Chairman.) With regard to the investigation of arsenic in fuel, what have you to say about that?—All the samples of coal or coke examined were found to contain arsenic. Two samples of anthracite used by two different maltsters were found to contain only minute quantities of arsenic, but it is possible that even after this material has been finely pulverised and treated with hydrochloric acid, some arsenic escapes detection by Reinsch's method. Four samples of gas coke were found to contain 1.46, 1.17, 1.14, and 1½ grains of arsenic per lb. respectively; possibly the whole amount present was not detected in all cases. It is almost certain that a larger amount of arsenious acid is liberated by combustion than these estimates by Reinsch's test would indicate. I collected some of the soot deposited in an ordinary chimney where South Yorkshire coals had been burnt for one week, and found that the soot contained 5½ grs. of arsenious acid per lb., arsenic estimated as arsenious acid. I collected the soot which had collected in one of the flues of a small closed stove, in which coke from the Manchester Gas Works had been burnt for a fortnight, and found that the soot contained about 28 grains of arsenious acid per pound. In the 113 grammes of soot which had collected in a small flue there was about ½ gramme of arsenious acid—2 grains of such a soot would be enough to introduce into 1 lb. of malt the amount which was found to be present in a sample of unscreened and unpolished malt. (No. 111 of Table 7.) The presence of this large amount of arsenic in the soot causes a marked arsenical contamination of the air in Manchester, and may account for the bad effect of this air on vegetation. From 30 grammes leaves of evergreens in my garden, which is not in the centre of Manchester, I obtained arsenic in sufficient quantity to make its detection easy, the amount being quite measurable (1.350 grain per pound). It is probable from this last observation that by using a delicate test minute traces of arsenic would be detected in many vegetable products, including hops, which had been exposed from time to time to air loaded with smoke from coal or coke furnaces or domestic fires. Soot may be carried in this way to considerable distances from manufacturing centres. It is, therefore, a question whether mere traces of arsenic in hops or barley can be entirely avoided. Malt and hops stored up in certain storehouses would also be exposed to a certain amount of contamination; a sufficiently delicate method of analysis would probably reveal traces of the poison in such materials. It is practically useless to push the method of analysis beyond a certain degree of delicacy, or we shall find arsenic in almost everything.

5248. Would there be arsenic in the dust on the top of bookcases, and so on?—Yes.

5249. Have you examined the ordinary dust in houses?—We have examined it, but we have not exactly estimated the amount of arsenic, and I would ask leave to add this estimation to the end of my tables.

5250. There is, I suppose, sometimes arsenic in the dust of years found on the top of a bookcase?—That dark dust in Manchester contains arsenic.

5251. But you have not measured it yet?—It has been partly done, but the estimation is not completed.

5252. (Sir William Church.) Is it not rather a new discovery that there is such a large quantity of arsenic

in common soot as is shown in your table? It was always known there was arsenic present where you got double sulphides or iron and pyrites in coal, but was it generally known that the soot contained so much arsenic?—I do not think it was known that the quantities were so large, but there was some knowledge of the general distribution of arsenic. Chemists who work at the detection of arsenic are extremely careful in their laboratories to avoid carrying out experiments which could cause dissemination of arsenic in the laboratory by dust.

5253. Was it ever suspected that there were 28 grains of arsenious acid in a pound of soot from the flue of a stove?—I do not think so, but when the facts of the case are considered this is not extraordinary because the coke itself is frequently made from very arsenical coal. All the samples of coke we have examined, retort coke, purified coke, and ordinary coke, contain arsenic. The effect of burning coke in a closed stove is practically to produce a distillation of arsenic and a formation of arsenious acid, just as if one intended to prepare arsenious acid for manufacturing purposes.

5254. It was the quantity that astonished me, not its presence?—The quantities astonished me at first. I was very much surprised to find them. You will notice that the quantity of material used for detecting the arsenic had to be gradually reduced to two-hundredths of a gramme. There was so much arsenious acid in the soot that we had to reduce the amount of soot for estimation to .025 before we could get a deposit that was small enough to be estimated.

5255. (Chairman.) It was too large?—Yes. At first we could not do anything, because there was so much arsenic in the material.

5256. Would it be easy by a special process to separate that 28 grains of arsenious acid from the soot?—It would be extremely easy. A simple washing would do it almost. It is in the form of arsenious acid chiefly, and could be separated by washing the soot with water.

5257. Or with a solution of potash?—An alkaline solution would remove it very much more rapidly than water.

5258-9. (Dr. Whitelegge.) You are going to tell us about the proportion of arsenic in Manchester dust?—Yes. The analysis is not completed. I went to the laboratory this morning to see if it was finished, but it was not.

5260. Are you making investigation about country dust?—I have not begun that yet, but I have made arrangements to do so.

5261. I suppose in country dust you would not anticipate anything like the same amount of arsenic, because it would not be so largely composed of soot?—I would not expect any far away from towns.

5262. Then hops growing in the country would not have much soot and arsenic condensed on their surface, would they?—Not much. I was considering a special case. I lived for some time at a distance of eight miles from Manchester, in Bowdon, where a number of shrubs had been gradually destroyed owing to the passage over the town of the smoke from various manufacturing towns, which are at various distances. Even in the hop districts there are several manufacturing centres; for instance, Reading is not far from certain hop districts, and it is not at all unlikely that soot from the chimneys there would be carried a distance of a few miles.

5263. (Mr. Cosmo Bonsor.) There are large Portland cement works which must make a considerable amount of smoke all down the Medway?—Yes. I am speaking tests for only of traces, and not of material quantities. My arsenic object is simply to show that the delicacy of the test for arsenic must be determined, or else the results will become practically useless.

5264. (Chairman.) In burning ordinary coal in an ordinary fireplace, is as much arsenic produced as with in coal coke fires?—Not so much, but I have given in my tables the quantity obtained from South Yorkshire coal, which I use in my house, and the quantity there was 5½ grains per pound.

5265. The less sulphurous coals would contain less arsenic?—I should think so. I suppose it is the presence of various ores in coal beds that gives rise to the presence of arsenic in the coal. Pure coals like anthracite contain so very little arsenic that it is not always easy to detect its presence.

Prof.
S. Delépine,
30 Mar. 1901.

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Need for
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Prof.
S. Delépine.
20 Mar. 1901.

5266. As a physiologist, do you think that breathing the air of a smoky town has any perceptible effect in respect to arsenic?—I would not like to make any definite statement on that point, but I have a suspicion that soot from towns where arsenical coal is used is far more irritating to the lungs than pure coal dust. The reason why I say so is, that I have noticed there is generally more fibrous tissue produced in the lung in town anthracosis than when the coal is inhaled as dust, as, for instance, in the case of coal miners; I find the lungs of coal miners may become as black as soot, and all the lymphatic vessels entirely distended with ordinary coal dust, without there being evidence of very distinct inflammatory reaction; whilst on the contrary in towns, where the amount of carbon collected in the lungs is smaller, there are frequently capsules of fibrous tissue in the lungs around small masses of carbon which have accumulated, indicating some irritating action on the part of the soot.

5267. So that we may take it the atmosphere of a coal mine is more salubrious than that of the City or West End of London?—That is what it comes to, except that there are other conditions not so favourable in coal mines as in the West End of London.

5268. (Sir William Church.) There are many other things besides arsenic which would account for that. Of course, you have not sulphurous acid in the coal mines?—Undoubtedly there are other things than arsenic. But at the same time arsenic being present in such a large amount in soot becomes a far more important factor than sulphurous acid, which probably rapidly disappears.

5269. Although it rapidly disappears, you can taste sulphurous acid in a London fog?—Yes, and it is there not worse than in Manchester.

Arsenic in
yeast.

5270. (Chairman.) You have also some experiments to put before us as to the action of yeast in regard to arsenic?—Yes. I made several experiments in order to discover the cause of the discrepancies between the amount of arsenic introduced with brewing material and the amount found in the finished beer. The following experiments were performed: *Firstly*, to show that pure yeast abstracts a material amount of arsenic from arsenical wort in the course of ordinary fermentation. Wort (without hops) obtained from a brewery contained about 0.5 parts of arsenic per 10,000,000 (about 1.280 grains per gallon). To 500 ccs. of this wort, about 2 milligrammes of pure low yeast (Carlsberg) were added, and fermentation was allowed to continue for four days. The fermentation was slow, and the fluid at the end had acquired a pleasant sweet, fruity smell. After the yeast had been separated the fluid was tested again for arsenic, only doubtful traces were found. The same experiment was repeated after the addition to the wort of arsenious acid to the extent of 20 parts to 10,000,000. The wort contained therefore 20.5 parts of arsenious acid to ten million parts of fluid. The quantities of yeast and wort were the same as in the above experiment and the fermentation was allowed to continue for the same length of time—the fermenting fluid had a pleasant but somewhat sour smell. At the end of the experiment the yeast was separated by centrifugalisation, 1.25 grammes of yeast being obtained in this way, after draining off the excess of fluid retained, so as to get the yeast in the same state as ordinary pressed yeast is, the weight of the yeast was 0.89 gramme, i.e., about 450 times the amount originally introduced. The quantities of arsenic found were as follows:—

Original wort before fermentation 20.5 parts of arsenic per 10 million parts.

Fermented wort four days after, about ten parts of arsenic per 10 million parts.

Yeast before fermentation, 0.

Yeast after fermentation over 2,500 parts of arsenic per 10 million parts.

Affinity of
yeast for
arsenic.

This would correspond to about 1.75 grains of arsenic per pound of yeast obtained at the end of fermentation. So that starting with highly contaminated wort and pure yeast, a very large amount of arsenic is taken up by the yeast before the beer is finished. *Secondly*: Part of the arsenic found in the moist yeast is due to the presence of fluid retained between the yeast cells. To obtain an approximate idea of the amount of fluid thus retained 30 grammes of ordinary pressed yeast were washed with water, and separated again by means of the centrifuge. After this process had been repeated several times the water was allowed to drain off the separated yeast,

which was then obtained in a pulvaceous mass, resembling the ordinary unpressed yeast, a certain quantity of that moist yeast was weighed, allowed to dry, so as to free the cells from the excess of interstitial water, and weighed again. It was found in this way that the weight of the yeast in a state of dryness resembling that of pressed yeast, was about 5-7ths of the weight of the moist yeast. The amount of fluid retained could not, therefore account for more than a fraction of the arsenic taken up by the yeast. This was shown also in another way. 30 grammes of ordinary baker's yeast contained 0.00024 grammes of As_2O_3 . 30 grammes of the same yeast after repeated washings and separation by centrifuge contained 0.00005 grammes of As_2O_3 . In this case only a little more than 1-5th of the original amount of arsenic was found in the yeast after thorough washing, but as the yeast was common baker's yeast, containing many damaged or dead cells, the contents of which would be partly or entirely removed by repeated washing, the amount found at the end does not represent the whole of the cellular arsenic. This amount is, however, sufficiently large to show that the yeast cells had retained a material amount of arsenic. *Thirdly*: Even arsenical yeast may remove some arsenic from badly contaminated wort. To 100 ccs. of wort (without hops), containing 1,000 parts of As_2O_3 per 10 million, were added 2 grammes of yeast containing 80 parts of As_2O_3 per 10 million. Fermentation was allowed to continue for four days, it was very active, but the fermented fluid had a sour not very pleasant smell. At the end of this time the fermented fluid contained less than 500 parts of As_2O_3 per 10 million; the moist yeast contained over 1580 parts of As_2O_3 per 10 million. A considerable amount of arsenious acid had therefore been removed from the wort, the amount of arsenic originally present in the yeast having been insufficient to saturate the young cells produced by the old arsenical ones. *Fourthly*: Arsenical yeast yields a distinct amount of arsenic to wort which was originally free from the poison or contained only a small amount of it. To 100 ccs. of wort (without hops) containing about 0.5 As_2O_3 per 10 million, were added 2 grammes of yeast containing 80 parts of As_2O_3 per 10 million. Fermentation, allowed to continue for four days, was very active; the fermented fluid had a sweet and fruity smell. At the end of that time the fermented wort contained 0.8 part As_2O_3 per 10 million; moist yeast (considerably increased in amount) contained 28 parts As_2O_3 per 10 million. The same experiment as the above was repeated, with the result that the fermented wort contained at the end of the fermentation 1 part of arsenious acid per 10 million parts. The amount of arsenic contained in the wort had therefore increased to a material extent through the use of arsenical yeast. The same experiment was repeated with arsenical yeast which had been allowed to go bad by being kept in a bottle for several weeks. This yeast had become semi-fluid, brown in colour, and had a bad smell. It contained a large number of dead and broken up yeast cells, and many putrefactive bacteria. To 100 ccs. of wort, containing 0.5 parts of As_2O_3 per 10 million were added 4 grammes of this bad fluid yeast, containing 82 parts of As_2O_3 per 10 million. Fermentation was allowed to continue for four days, at first the growth of the yeast was very slow, and the fermenting fluid had a very unpleasant putrid smell, and was very turbid (putrefactive bacteria) at the end of four days the growth of the yeast had become more normal and the smell almost pleasant, and not unlike that associated with normal fermentation. At the end of that time the fermented fluid contained about 5 parts of As_2O_3 per 10 million, the separated yeast contained about 4 parts of As_2O_3 per 10 million. *Fifthly*: In trying to obtain arsenic-free yeast in the ordinary market it became evident that it was practically impossible to obtain such an article in Manchester. The following results were obtained with samples from five different sources:—

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|-----|---|----------------------------|
| (1) | Baker's yeast (from baker) | - 80 parts per 10 million. |
| (2) | " " same source as 1. | |
| | 26 days later | - 40 " " |
| (3) | " " "Scotch" (from importer) | - 40 " " |
| (4) | " " other than 1 (from baker) | - 40 " " |
| (5) | " " "German" (so-called really imported from Holland) (from grocer) | - 25 " " |

Bread made with one of the samples of yeast (1) was tested for arsenic. This bread was obtained from the

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Prof. Delépine. baker from whom the yeast had been obtained; it contained less than 0.25 parts of arsenic per 10,000,000, i.e., less than 1-5600th part of a grain per lb.

Mar. 1901. 5271. (Mr. Cosmo Bonsor.) Did you happen to analyse the beer drawn off from the yeast?—Yes. We have not pressed it, but we have washed it, and estimated the amount of arsenic found in the fluid used for washing the yeast.

5272. When the yeast comes down it contains a certain amount of beer which is practically recovered by pressing?—That would contain a large amount of arsenic.

5273. Was that beer tested separately?—Not that beer, but the fluid which we obtained by washing the yeast was tested. That was not exactly what would correspond to the beer obtained by pressing, because if the yeast is kept for some time, and pressed afterwards, a number of yeast cells get broken up, and the amount of arsenic obtained under those conditions would be greatly in excess of anything we found.

5274. (Chairman.) Is it not dangerous to use the same yeast over and over again?—Yes, to a slight extent.

5275. The yeast increases?—Yes.

5276. The usage is to take a sufficiency of the yeast that has been already used, and use it in a fresh brew?—Yes.

5277. Does that go on indefinitely?—Yes. The yeast when it is badly contaminated and placed in wort free from arsenic, can yield to the wort a certain proportion of arsenic which is not taken up at once by the young yeast. Young yeast abstracts afterwards a large proportion of the arsenic yielded in the first instance by the old yeast, but there may still remain some arsenic which is not abstracted in that way.

5278. The use of yeast from a brewery by bakers is common, I believe?—Yes, I have heard that this is the case.

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st."* 5279. Is there not a danger, therefore, of introducing arsenic into bread?—Yes. We found actually that all the bakers' yeast we could get in Manchester contained arsenic to a greater or less extent, and the bread made with that yeast also contained arsenic, but in a very small quantity. I have also examined a sample of Chinese yeast, which is not the same kind of yeast as that used here, but a kind of mould, which is generally grown on rice for the purpose of making a fermented liquor. I found it contained only a minute trace of arsenic. This was rather interesting with regard to beri-beri. It has been supposed that the rice may become contaminated with arsenic owing to the practice which the Chinese have of using arsenic rather indiscriminately, and thus become a source of arsenical poisoning. I thought that by examining a mould grown on rice in those countries if there was much arsenic in the rice, we should find it in the fungus, but we have not found much arsenic in that yeast—less than half what we have found in the best German yeast (5) we have examined.

5280. Were the quantities of arsenic you found in bread so great as to be dangerous to health?—They are extremely minute. It is difficult to estimate accurately such small quantities, but there seemed to be less than 1-5,000th part of a grain of arsenic per pound of bread, which I believe is practically negligible.

5281. So far as the specimens of bread you have examined go, there is no danger to the public health?—I do not think so, but of course I would not like to offer a very positive opinion on that point. It seems to me quite improbable that 1-5,000th part of a grain per pound can do any harm to anybody.

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le.* 5282. (Dr. Whitelegge.) You think of the arsenic as being assimilated by the yeast cell?—I do not know whether it is actually assimilated—it is taken up by the cell.

5283. It is inside the cell?—Yes. The yeast was washed with a large quantity of water. The water after being separated from the yeast contained a large amount of arsenic. Then the yeast was washed a sufficient number of times to remove any trace of arsenic from between the yeast cells, and when the water was practically free from arsenic—it is almost impossible to get it absolutely free from arsenic, because some yeast cells break up one after the other it was found that a very material proportion of arsenic was retained in the thoroughly washed yeast cells.

5284. All you wish to say is, that the arsenic must be inside the cell.

5285. But you do not express any opinion whether it was in chemical combination, or present as arsenious acid inside the cell?—I would not like to say. The only

thing I can say at this stage in favour of the view that it enters into combination is that its presence favoured the growth of yeast to an extraordinary extent. Yeast grows much more rapidly in an arsenical solution not containing too great an amount of arsenic, than in an ordinary solution containing no arsenic. This seems to indicate that it has some effect upon the metabolism of the yeast cell.

5286. (Mr. Cosmo Bonsor.) Practically the action of fermentation reduces the amount of arsenic which gets into the wort?—To a considerable extent.

5287. We have it in evidence that Bostock's invert sugar was used for priming, and did not go through the process of fermentation at all. If it had gone through the process of fermentation we may presume that it would not have been so harmful as it was in the way it was used?—I think so; but priming was not used in the case of all the beers in which we found arsenic.

5288. There was priming in the cheaper ales?—Yes, but we found a good deal of arsenic in the better ales, too.

5289. But not in the same quantity?—No.

5290. (Chairman.) In those instances where you detected arsenic in hops, you estimated it about 1-200th of a grain per pound?—Yes; that would mean, on the supposition that as much as 1 per cent. of hops was used, a minimum of 1-2000th of a grain of arsenic added by the hops to a gallon of beer. The largest amount of arsenic we found in hops was 1-80 grain.

5291. You have some experiments on the action of hops free from arsenic when boiled with arsenical wort?—Yes. I found that during the boiling of arsenical wort with hops an appreciable amount of arsenic is taken up by the hops. 500 ccs. of arsenical wort were boiled for two hours with 5 grammes of arsenic-free hops (1 part of hops to 100 parts of wort). The fluid at the end of this was filtered, being caused at the same time to pass through the hops to imitate the usual filtration of wort through hops. The amount of fluid retained by the hops at the end of this process was calculated by difference. The original weight of dry hops was 5 grammes, the weight of moist hops 23 grammes, amount of fluid retained 18 grammes. The amount of arsenic present in the wort and in the moist hops was then estimated by the modified Reinsch's process, with the following results:—Arsenic in wort filtered through hops, about 10 parts per 10 million. Arsenic in moist hops (5 grammes hops, 18 grammes wort), 21.75 parts per 10 million. The amount of arsenic removed by the hops may be calculated as follows:—Quantity of arsenic found in 23 grammes of moist hops, 0.00005 grammes; quantity of arsenic present in the 18 grammes of wort retained by the hops, 0.000018 grammes; quantity of arsenic therefore taken up by the 5 grammes of dry hops, 0.000032 grammes. On the supposition that one part of hops is used to 100 parts of wort, the amount of arsenic stopped from arsenic-free hops would be about 1-50 grain per gallon of beer.

5292. You also endeavoured to ascertain whether in brewery brewing plant might become contaminated with arsenic?—Yes; I performed the following experiments in this direction. In view of the extensive use of copper utensils in brewing, I endeavoured to see whether arsenic would be deposited on the copper during the boiling of arsenical hops in wort. Arsenious acid was added to fresh wort, so as to bring the total amount of arsenic present to 20.5 parts per 10,000,000, i.e., a little over 1.7 grammes per gallon; 5 grammes of hops were added, as well as two pieces of copper (no hydrochloric acid). The mixture was boiled for two hours. At the end of that time the copper was found to be very slightly dulled, but no sublimate of arsenic could be obtained from it. It is therefore evident that no appreciable precipitation of arsenic similar to that which occurs during the application of Reinsch's process takes place whilst the wort is boiled in copper vessels. Any arsenic which may be found in the deposit of coagulated matter is independent of the action of copper.

5293. That shows that none of the arsenic settles on the copper in the regular brewing process?—Yes.

5294. Have you anything to say on the storage of arsenic in the wood of the fermenting tun?—A piece of oak measuring 2 x 2 x 1 inch was immersed in 500 ccs. of wort, to which 5 grammes of yeast had been added. The wort contained 20.5 parts of arsenic per 10,000,000, the yeast 80 parts per 10 million. At the end of four days' fermentation it was found that the fluid had not penetrated very deeply into the wood. After wash

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More arsenic in beer if arsenical sugar used as priming.

Arsenic in hops.

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ing this piece of wood with distilled water, the piece was divided into fine splinters, suspended in 200 ccs. of water, and tested in the usual way. A sublimate of arsenic corresponding to less than $\frac{1}{100,000}$ was obtained. This experiment shows that some arsenic is retained by the wood, but does not indicate that wood has the power of abstracting arsenic from the wort. There was in the solution a large amount of yeast; the wood was new, and was not easily penetrated by the wort, so that the experiment is not conclusive. In a second set of experiments two blocks of oak similar to the block used in the first experiment, and weighing respectively A 50.90 grammes, and B 52.5 grammes, after being rapidly immersed in water and dried with filter paper, were used. These blocks were kept immersed for four days in fermenting wort containing 100 parts of arsenic per 10,000,000. At the end of that time, both blocks were removed, and rapidly washed to remove the yeast and wort adhering to their surface. They were then dried with filter paper and weighed. Block A weighed 58.16 grammes, having retained 7.26 grammes of wort, block B weighed 60.1 grammes, having retained 7.6 grammes of fluid. Block A was then divided into fine splinters, suspended in 200 cc. of water, and the mixture tested for arsenic. The proportion of arsenic contained in the 7.26 grammes of fluid retained was found to be equal to 138 parts in 10,000,000; i.e., 38 parts over the amount originally present in the wort. The wood seemed therefore to have had some power of storing arsenic. Block B was placed in 120 cc. of pure lager beer free from arsenic, in which it was allowed to remain for 24 hours, the temperature being 37°C. At the end of that time the fluid was tested for arsenic, which was found to be present in the proportion of 2 parts to 10,000,000. A material amount of arsenic stored up in the wood had therefore been yielded to the beer.

5295. In the wood used in the brewery arsenic goes on accumulating?—Yes. The reason why this part of the investigation seemed necessary was, that we had often found the first beer brewed from hops and malt alone in breweries where invert sugars had been used previously, contained more arsenic than we expected to find on account of the hops and malt alone, and this investigation into the brewing plant became necessary in order to find why there was a discrepancy between these results.

5296. (Mr. Cosmo Bonsor.) In that particular instance you have mentioned, I suppose they changed their yeast entirely, and got uncontaminated yeast for the following brewing?—I do not know.

5297. If the yeast were used it would account for carrying on the arsenic for a considerable number of years?—Not exactly. If yeast is used for two or three brews, the wort being practically pure, the yeast will purify itself very rapidly, the young yeast taking up the arsenic brought in by the old yeast, and after a short time the amount of arsenic present in the yeast would become infinitesimal, and there could not be any transference of arsenic to the beer.

5298. (Dr. Whitelegge.) Can you say whether the plant had been cleansed in the usual way for this examination?—I think it had been thoroughly washed. The pieces of wood I experimented with were also washed before they were put into beer to see whether any arsenic would be yielded.

5299. (Mr. Cosmo Bonsor.) Would scalding destroy arsenic in a wooden vessel?—I do not think so. It would take a long time to remove all the arsenic which had collected in the wood of fermenting tuns and barrels. I think the only way would be a long soaking, very prolonged soaking, especially with some fluid containing a certain amount of alkali, soda, or potash.

No evidence
of formation
of arseniuretted
hydrogen
in contamin-
ated beer.

5300. (Chairman.) I think you have some observations on the possible presence of arseniuretted hydrogen in beer?—Yes. Savitsch, Johansohn, and Schultze have shown that arsenic does not necessarily interfere with the growth of yeast, but may modify its actions. Schultze states that a proportion of arsenic equal to 1-40,000 augments the activity of yeast. Johansohn finds that when the amount of arsenic is increased, the growth of yeast is interfered with and ultimately arrested. A quantity of arsenic sufficient to interfere with yeast is, however, insufficient to stop the growth of many putrefactive bacteria and moulds. These organisms, by assimilating the oxygen and carbon of organic compounds, set free a certain amount of nascent hydrogen, which produces some arseniuretted hydrogen at the expense of arsenious acid. That is the theory offered by Johansohn. It might therefore be reasonable to assume that arseniuretted hydrogen, which is one of the most highly poisonous

compounds of arsenic, was present in small quantities in beer brewed from arsenical glucose. There was, however, no evidence of the presence of this gas in the beers examined. On the other hand it seemed improbable that any amount of this gas should be retained in a fluid kept in open vessels and saturated with carbonic acid constantly evolved. No evidence of the presence of this gas was obtained when the Marsh test was applied to untraced beer, small traces might have, however, escaped detection. To clear this point I devised the following experiment: 300cc. of wort containing 200 parts of arsenic per 10,000,000 parts, with 3 grammes of arsenical yeast containing 66 parts of arsenic per 10,000,000 were allowed to ferment in a closed flask—6,000cc. of air were made to pass at intervals through that flask, the air removed from the flask being made to bubble slowly through neutral silver nitrate solution. At the end of four days there was only very slight evidence of reduction of silver, which was most marked in the last bulb (exposed to light). This solution was tested for arsenic with negative results. Therefore, I think the question of arseniuretted hydrogen can be entirely dismissed.

5301. Have you found any evidence of the presence of selenium in the beers you have examined?—No. Selenium, like arsenic, is very widely distributed, is frequently present in pyrites from which sulphuric acid is prepared, and is specially abundant in pyrites and other minerals coming from certain countries, e.g. Norway and Hartz Mountains. It was therefore possible that minute traces of selenium might be present in impure sulphuric acid, but it was certainly not present in any appreciable quantity in our sample of the sulphuric acid used by Messrs. Bostock and Company. No red precipitate or coloration was produced by sulphurous acid in the two samples of sulphuric acid which we obtained from those manufacturers. To ascertain whether the test we had applied was sufficiently delicate, I obtained some selenium and some selenic acid. A solution of selenium in fuming sulphuric acid was prepared and diluted with H_2SO_4 . One part of selenium in 10,000 parts of pure sulphuric acid had a very distinct pale greenish-yellow colour. On floating a solution of stannous chloride on the surface of the acid a brownish-red coloration and precipitate were produced. On diluting the 1/10,000 acid solution with some water a reddish-yellow coloration and cloudiness were produced. The arsenical brown oil of vitriol obtained at the sugar factory on being diluted became clearer, and assumed a pale greenish tint (due to the presence of iron). Stannous chloride produced no red line or precipitate. The same results were obtained with $SnCl_2$ after the addition of selenic acid to pure sulphuric acid. 1cc. of a 1 in 400 solution of selenium in sulphuric acid, after being neutralised with ammonia, was tested by Reinsch's method. A soot-black precipitate was produced on the copper; this could not be volatilised like arsenic in the sublimation tube, and remained unaffected. From none of the samples of beer or other material examined in my laboratory had a similar deposit been obtained. This deposit was soluble in fuming sulphuric acid giving a green solution, which on being diluted with water yielded a reddish precipitate. Considering the facts that the sulphuric acid contained from 1.4 to over 2 per cent. of arsenious acid, and that no trace of selenium was revealed by tests which showed easily the presence of 0.01 per cent. of selenium, I think that selenium cannot have had any appreciable share in the production of the outbreak.

5302. (Chairman.) The black deposit produced by selenium was not volatile?—No. It would be volatile under the influence of sufficient heat, but not like arsenic in the sublimation tube, when the tube is not overheated. We got absolutely no sublimate, and the colour of the copper was very different from what we obtained with arsenical products. In addition to that, the deposit could be dissolved from the surface of the copper with fuming sulphuric acid, giving clearly the green colour of a solution of selenium in sulphuric acid, and this colour gave place at once to the red discoloration which is produced by dilution with water. So that it would be practically impossible to overlook the presence of material quantities of selenium. On diluting the H_2SO_4 for the purpose of applying various tests, one would get the red precipitate on the addition of water.

5303. (Sir William Church.) Very little is known of the action of selenium or its salts upon animals?—I know nothing from personal experience. Of course if selenium had been present it would have been worth while enquiring into its action in connection with the present enquiry, but as with a solution of one in

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[ar. 1901.] 100,000 I got reactions which could be quite easily recognised, and no such reaction was observed. I think the theory that selenium was a material factor in the production of the epidemic can be put aside.

5304. I asked you the question because it has been put to us by one witness that he was not satisfied from the description of effects of arsenic that the arsenic could account for it, and he thought it might be due to some other matter being present, and selenium suggested itself, because selenium in animals produces marked wasting?—I shall be able to show that the amount of arsenic present in the beer which we have examined is quite sufficient to produce all the symptoms which have been observed in the epidemic.

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5305. I should also like to know if you have any opinion whether sufficient is as yet known of the action of selenium on man to draw any inference?—I should say I know so little that it is impossible for me to say anything.

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5306. Have you formed an opinion as to what dose of arsenic administered with beer or food may be considered so small that it may be safely disregarded?—Arsenic is so widely distributed in minute quantities in nature that the finding of small quantities of it would have been of very slight assistance to the public authorities unless one was in a position to state at the same time that the quantity found was sufficient to account for the production of disease. In the absence of authoritative statements on the subject, it seemed to me that the only guide one could take was the experience of the therapist. It is generally believed that it is almost useless to administer for medicinal purposes less than 1-28th grain of arsenious acid in the day (this dose corresponds to about two minims of Fowler's solution taken twice a day). Such a dose may be taken for a considerable time by most people without any bad effects, but allowing for idiosyncrasy and disease, it would not be advisable to take such a quantity of arsenious acid daily, and more or less continuously, without knowing it and without medical advice. About smaller doses there might be differences of opinion. I felt, therefore, justified, on the assumption that most beer drinkers consumed half-a-gallon of beer daily, that whenever a beer contained as much as or more than 1-28th grain of arsenic in half-a-gallon, that beer should be condemned. Since then I have learnt that one gallon is not an unusual allowance, so that I have had to lower the limit which I had at first adopted. As I had found that it is comparatively easy to estimate an amount of arsenic in beer equal to one part in 10,000,000, and as 1-28th grain per gallon corresponds to one part in 1,960,000 parts, there is no difficulty in detecting an amount of arsenic which is injurious in this sense. Any prosecution based on the finding of such a quantity would be justified on the ground of sound experience. With regard to somewhat larger, though still small, medicinal doses, there are certain statements which leave very little doubt as to the dangers connected with those doses. Thus Lachèse (*Annales d'Hygiène, Series I, xvii., 1834*) states that six milligrammes of arsenic (about 1-11th grain) produce decided though not serious symptoms, and that doses of 10 to 30 milligrammes (1-6th to under $\frac{1}{2}$ grain) have been toxic though not lethal. Jaccoud (*Traité de Pathologie Interne II., p. 1,002, 1877*) speaks of the danger of a continuous administration of doses of arsenic ranging from 1-11th to 1-6th grain daily. He says that such doses may be taken for weeks and sometimes months without bad effects, and often with benefit, but that a limit of tolerance is frequently indicated by symptoms of chronic poisoning, beginning insidiously, and getting rapidly worse unless the drug is stopped. This he attributes to a saturation of the tissues or what we would term now cumulative action. Maerck gives in his atlas of Diseases of the Skin (English Edition, p. 136, 1900) a picture of arsenical hyperchromatosis of the skin (arsenical pigmentation) taken from a patient who in three months and a-half had taken 900 drops of Fowler's solution. The patient had been treated for four weeks in July and for six weeks from late in August into October. Both times the treatment had begun with five drops of Fowler's solution daily, and reached in the first course of treatment 20 drops, and in the second period 25 drops daily. This patient had taken in the course of 100 or 105 days about four grains of arsenious acid (in the form of arsenite of potash), making an average daily dose of about 1-25th grain daily, the actual extreme doses taken daily ranging from $\frac{1}{4}$ th grain to 1-40th grain. (The same author mentions other cases

in which $3\frac{1}{2}$ grains and $1\frac{1}{2}$ grains had been sufficient to produce pigmentation.) The symptoms observed in that patient having been typical of chronic arsenical poisoning, it is evident that the arsenical beer drunk in Salford contained more than enough to account for the symptoms of arsenical poisoning. Of the beer containing $\frac{1}{2}$ grain of arsenious acid per gallon, half a glass taken daily would have been sufficient; of the beer containing $\frac{1}{4}$ grain to $\frac{1}{2}$ less than one pint; of the other beers from half to one gallon, or a little over, would have supplied enough arsenic. The few cases of chronic poisoning I have mentioned do not at all exhaust the list of cases in which one could find evidence of the action of an arsenious acid or arsenites in doses which were not larger than those present in the beer. I have simply given a few very typical cases, which I had no difficulty in finding, but I have no doubt more cases could be found.

5307. Then in your opinion there was quite enough Individual
of the poison to account for the symptoms in even moderate susceptibility
rate drinkers?—Yes. I think it is a fortunate thing to arsenic.
that all are not equally susceptible to the action of arsenic, and that many persons can take larger doses of the drug without being injuriously affected by it. In the case recorded by Dr. Heaton in the "Lancet" (26th January, 1901), $5\frac{1}{2}$ grains of arsenious acid, $10\frac{1}{2}$ grains of sodium cacodylate, 105 grains of arsenate of soda, were all taken by a patient without bad effects in the course of 271 days, including intervals amounting to 58 days. The maximum dose administered at one time being $2\frac{3}{4}$ grains of sodium arsenate, which in toxic power would be equivalent to about $\frac{1}{2}$ grain of arsenious acid. These facts seem sufficient to account on the one hand for the occurrence of a number of instances of arsenical poisoning in moderate drinkers, and on the other hand for the escape of a number of other consumers. The same facts make it unnecessary to assume the presence in beer of any substance more poisonous than arsenious acid or arsenites.

5308. In what you have been saying you refer to quantities of arsenic which have produced distinct effects easily recognisable by medical men as due to arsenic. Is it possible that doses of arsenic smaller than those which have been known to produce distinct effects might, when taken continuously for a considerable time, produce illness which would not obviously be attributed to arsenic?—I think it is quite possible, and it is obvious that if there is any doubt on that point, the presence of any appreciable quantity of arsenic is objectionable. We have found that certain samples of beer were quite free from appreciable traces of arsenic: it might therefore be urged that any beer containing a trace of arsenic should be condemned. Our investigation has shown, however, that small traces of arsenic are so difficult to avoid, that to exclude arsenic entirely from our diet would probably be an impossibility. It is therefore necessary for practical purposes to fix a certain maximum limit of the amount of arsenic which may be tolerated in beer. This is a matter of some difficulty, for we have absolutely no record of observations upon which such a limit could be based. It will not be possible to fix such a limit otherwise than in an arbitrary fashion, until a large number of articles of food and drink, which have been found to be wholesome by the experience of several generations, have been analysed, and the amount of arsenic which they may contain has been determined. We have already some data of this kind. We know that beer brewed from malt and hops only has been drunk without causing marked outbreaks of disease. We also know that the amount of arsenic present in malt dried in old-fashioned kilns may be large enough to account for about 1-50th of a grain of arsenic in a gallon of beer, and in exceptional (probably very rare) cases for as much as 1-30th or possibly 1-25th of a grain per gallon. Old kilns and bad fuel have undoubtedly been used for a long time, so that beer containing from 1-30th to 1-50th of a grain of arsenic must have been drunk in large quantities. It is equally clear that beer brewed in the Northern Counties must have usually contained from 1-300th to 1-100th of a grain of arsenic per gallon. There has not, however, been usually any excessive mortality, recognised as being connected with beer drinking. There are, however, certain lesions usually attributed to alcohol and which occur in beer drinkers; among these I may mention alcoholic neuritis and certain lesions of the liver. Dr. Reynolds, as far back as 1890, attracted attention to the fact that so-called alcoholic peripheral neuritis was not necessarily due to alcohol, since it seemed special to beer drinkers, and did not affect to any marked extent pure spirit drinkers.

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S. Delépine.

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Cirrhosis of
liver and
arsenic.

I have myself taught for many years the view that cirrhosis of the liver, which is usually indiscriminately attributed to alcohol, was probably in most cases due to the action of various poisons, bacterial and others, acting independently of or in conjunction with alcohol. Many of those protoplasmic poisons, when acting in large and fatal doses, cause a rapid degeneration of cells which have become highly specialised for certain functional purposes. The same poisons when acting in smaller doses produce also irritation, the effects of which are most noticeable in the connective tissue supporting the differentiated cells and in the cutaneous epithelium; this irritation leads to an increase of fibrous tissue, or, in other words, cirrhosis, and to various cutaneous lesions. Arsenic acts in this way comparatively rapidly. Alcohol, on the other hand, is a much less powerful poison, and acts very slowly, that is, in the usual doses taken by an ordinary drinker. In my view alcohol cannot, by its direct action, be the essential cause of the increase of connective tissue found in the liver of a certain proportion of beer drinkers, more especially when there is some evidence to show that such an increase has taken place within a comparatively short interval of time. On these grounds it is therefore reasonable to look with suspicion upon the presence of even small quantities of arsenic in beer (as well as in other foods or drinks). With the object of finding how much arsenic might be taken daily without apparent bad effects I have collected analyses of some arsenical mineral waters.

Arsenic in
Vichy water.

5309. These analyses are in a table?—Yes. They are given in table 13 (p. 357). Of the waters in that table, the Vichy is one drunk by a considerable number of people (the springs are visited by about 40,000 people annually, and a large quantity of the water is exported). According to Bouquet's analyses the water from the various springs contains from 0.002 to 0.003 of arsenate of soda per 1,000, i.e., from 20 to 30 parts per 10,000,000. So that when the maximum dose is taken a patient may be taking as much as 1.20th grain of arsenate of soda daily. It must be remembered that arsenate of soda is much less poisonous than arsenites or arsenious acid (according to Rouyer, in dogs the toxic dose of arsenite of potash and of arsenious acid is 0.06 gramme per kilogramme, the toxic dose of arsenate of soda is 0.15 gramme per kilo). During a course of Vichy waters a patient may take a daily dose of arsenic equivalent to quantities of arsenious acid ranging between 1.224 grain and 1.45 grain, with benefit. It must be remembered, however, that some patients do not tolerate this treatment quite well, but it is impossible to say whether the intolerance is due to arsenic or not: the subject may be worth investigation. Considering the large number of people who have taken these waters without any symptoms of arsenical poisoning having been detected, and frequently with benefit, it is probable that a quantity of 1.50th grain of arsenic per gallon of beer is harmless, provided arsenic is not present in a form more poisonous than arsenious acid. It would appear therefore that when beer, sound otherwise, does not contain more than 1.100th grain of arsenic per gallon, in the form of arsenious acid or of an arsenite, it is probably a quite safe drink.

5310. Do you call alcohol a poison, taken in the quantity which would be taken by a moderate drinker?—No, but it does seem when taken in large doses to interfere with nutrition. I have animals just now which are taking various alcoholic and arsenical drinks, and when the amount of alcohol is large, it seems to interfere with their nutrition, nearly as much as the arsenic—in fact more.

Toxic effect
of adminis-
tration of
of arsenic and
alcohol
together,

5311. But in small and moderate doses may arsenic be regarded as a food?—It can be considered as a food, but not the best kind of food. I have made a number of experiments to estimate whether the toxic power of arsenical beer was not greater than that of solution of arsenious acid in water. In order to find out whether the presence of arsenic in beer gave rise to specially noxious compounds, or whether the association of arsenic and alcohol was particularly detrimental to health, I have also made some other experiments which have extended over two months, and have already yielded clear results. The experiments are still going on, and if I might be allowed to do so, I should like to complete my statement by submitting to the Commission additional facts in the next month or two.

(Chairman.) We shall be very pleased to receive them.

to rodents.

(Witness.) Several rats, placed under absolutely identical conditions, and fed exactly in the same way,

the amount of food being directly in proportion with their body weight, were given daily definite quantities of the following fluids:—(1) Arsenical beer, with a little alcohol (under 5 per cent.), the daily dose being equal to what over one gallon of beer would be to a man 140 lbs. in weight; (2) arsenical beer with little alcohol, in daily doses corresponding to 2 gallons; (3) solution of arsenious acid in water varying in strength from 1.14 grain to 1.7 grain per gallon, quantity administered corresponding to 1 gallon; (4) solution of arsenious acid of the strength of 1.7 to 7 grains per gallon, quantity given corresponding to 1 gallon; (5) bitter beer containing 10 per cent. alcohol, to which 7 grains of arsenious acid had been added per gallon, the quantity administered corresponding to over 1 gallon; (6) bitter beer containing 10 per cent. alcohol, without arsenic, the quantity administered corresponding to over 1 gallon; (7) beer from which alcohol had been driven off by boiling, and to which arsenious acid had been added in the proportion of 7 grains per gallon; (8) lager, Munich beer, free from arsenic, the quantity administered corresponding to about two gallons daily. I have found that so long as the amount of arsenic in beer did not exceed $\frac{1}{2}$ grain per gallon, the animals thrived well, and increased more rapidly in weight than those taking watery solutions of arsenious acid, even when the quantity of fluid administered reached 17 per cent. of the body weight. This was true only so long as the amount of solid food was large. By reducing the amount of food to 1.30th of the weight of the animal, a very rapid loss of weight was produced which was much more marked in animals taking arsenic than in those which did not. Rats seemed to take the beer freely. They drank the beer so long as it did not contain a large amount of arsenic, but when the quantity of arsenic reached 7 grains per gallon, which is very much in excess of anything contained in any beer we have examined, they left usually about an eighth or a tenth of the beer given daily. They also took water readily enough, even when it contained arsenic, but they took arsenical beer very much more readily than arsenic and water. (A chart of the experiments was exhibited by the witness to the Commission.) When the amount of food diminished, the animal taking arsenic suffered from rapid loss of weight, which was not observed in an animal not taking arsenic. So that a small dose of arsenic had a very much more serious effect on an animal not taking sufficient food, than on an animal taking a sufficient toxic amount of food. Alcohol given in large quantities produced somewhat similar effects but less rapidly. From this I came to the conclusion that probably those who fell victims to the action of arsenic were mostly those who were ill-fed and diseased, and that the majority of those who were well fed might take a very considerable amount of arsenic without feeling any bad effects.

5312. (Mr. Cosmo Bonsor.) That is the reason why women suffer so much more than men probably?—Yes, I think that has a great deal to do with it.

5313. (Chairman.) You think then that special conditions favour the action of arsenic?—These experiments so far show that small doses of arsenic act very much more powerfully on ill-fed individuals than on well-fed individuals. The post-mortem examinations of fatal cases also show that in a large proportion of those cases some disease was present which must have weakened the resistance of the tissues. Many of the cases were tuberculous. Dr. Moore, assistant lecturer in pathology at Owens College, who has made many post-mortem examinations of victims of arsenical poisoning at the Crumpsall Hospital, and at the Royal Infirmary, has reported to me that he has found tuberculous lesions in nearly all of them. Alcohol when taken in large quantities also interferes with nutrition; this was well shown in my experiments. These facts seem to explain why so many among the poor have fallen victims of this arsenical contamination; though some accurate statistics would be necessary to show that this special incidence is a real, and not an apparent one only. The importance of suitable feeding, and of resistance of the tissues explains also why women have been more liable to the poison than men. I have had opportunity to observe and to hear that among the poorer classes women have frequently a very unsatisfactory diet, composed in great part of bread, farinaceous foods, butter, or some substitute, etc., and tea. The male worker on the contrary considers good and substantial feeding a necessity. Women are also exposed to the weakening influence of abnormal menstruation, to various troubles at the menopause, and occasional pregnancies. These influences are

sources of weakness special to women. It may also be supposed that the more active occupations of men favour the elimination of arsenic by the skin, and by other excretory organs. This last explanation, however, would not be in itself sufficient, for arsenic is usually eliminated rapidly by various glands, and in the case of women Brouardel and Pouchet have shown that so much arsenic can be secreted by the mammary gland that a suckling child may give clear evidence of arsenical poisoning, and even succumb when the mother has taken a large amount of arsenic. The very considerable elimination of arsenic by the skin and its accumulation in the hair, demonstrated by the same authors, and regarding which Professor Dixon Mann has made interesting observations, does not seem to be necessarily determined by exercise. It will be noticed that the first effects of even large doses of arsenic in a well-fed animal is an increase in weight; the instability of this state is, however, shown by the great and sudden fall following diminution of food. Judging by the notices appearing in the newspapers of deaths attributed to arsenical poisoning, I believe that most of the fatal cases before the end of 1900 occurred in women, very few men being affected. Since the 1st of January the proportion of men has considerably increased; this seems to show that the greater mortality among women in the early part of the outbreak was due to their succumbing more rapidly than men, and not necessarily that they were more addicted to drink than men are. More satisfactory statistics than those available to me will, however, be necessary before this explanation can be considered well-founded. The statistics collected by Dr. Tattersall show that the special liability of women was most marked between the ages of 40 to 50, i.e., about the critical time of life. This supports also the view that women are specially liable on account of want of resistance. It may, however, be also urged that intemperance is more frequent at that time of life. I think, however, that the greater fatality observed in women must have been chiefly due to malnutrition, various deteriorating influences inherent to their sex, and to their sedentary habits, and that generally speaking disease and other debilitating influences have been most important factors in determining the fatal termination of those cases of poisoning which have ended in death.

5314. Can you tell us anything with regard to arsenic found in the bodies of beer drinkers?—A case I may mention is that of a woman aged 44, who was admitted to Manchester Workhouse Infirmary on October 12th, 1900, and who died at the end of February, 1901. The peripheral neuritis was not severe, but progressive. There was no pigmentation. There was pleural effusion, with extreme wasting, contractures, and incontinence. The thyroid gland contained somewhat less than eight parts per 10 millions; the spleen less than three parts per 10 millions, and the bodies of the vertebrae about 3.5 to 4 parts per 100 million. Calculated on the basis of the amount of arsenic in the spleen, the total amount of arsenic retained in the body of a person weighing 140 lbs. would have been about 1-10th grain. As the spleen is not known to have the power to retain more arsenic than have other tissues, the quantity actually present in the whole body would probably be more than 1-10th grain. Another patient, a male, aged 50, was admitted to Crumpsall on November 3rd, 1900. His illness was said to have begun about the middle of September. There was cough, dyspnoea, and oedema. On admission there was marked peripheral neuritis, enlarged liver, and deep general pigmentation. There was also pneumonia or tuberculosis, and he died on March 1st. There was less than five parts per 10 millions in the thyroid gland. Two other cases which had been respectively three months and 15 days in hospital showed either no trace or doubtful traces of arsenic in the organs examined, in those cases the thyroid body did not appear to contain more arsenic than other organs. These examinations were made specially with the object of finding whether the thyroid body had a special power of storing up arsenic, and also how long arsenic might be retained in the tissues after the use of arsenical beer had been stopped. As far as was known, the patients were not taking any arsenic whilst in hospital. The presence of arsenic in the skin, liver, and other organs of arsenical beer drinkers was being investigated by Professor Dixon Mann, and did not form the object of any enquiry on my part. I am indebted to Dr. Reynolds for facilities to obtain information about his cases, and to Dr. Moore and Dr. Muir for the collection of material and facts which I required.

4576.

5315. You have some general results of autopsies of fatal cases of arsenical poisoning?—I have a letter from Dr. Craven Moore giving some of the results of autopsies on cases of arsenical beer poisoning. Dr. Craven Moore states that typical periaxial degeneration of the peripheral nerves, varying in degree, has been found in the twelve cases so far investigated by him, and that the liver in many of the cases presented irregularly-distributed congestion, degeneration, and varying degrees of cirrhosis. He also states that the skin in many of the cases was pigmented in various degrees.

5316. With regard to the presence of arsenic in food and preservatives, have you made any investigations into that matter?—I have asked Dr. Coutts to investigate some articles of food which had been sent to me, and to determine the presence or absence of arsenic and the sources of poison when present. The amount of arsenic found in several substances which are used as preservatives has important bearings upon the present inquiry, and I put in Table II. (Appendix No. 12) the facts which he has given me.

5317. (Sir William Church.) What is the probable source of the arsenic in shrimps?—Possibly some borax used as a preservative. We have not been able to obtain the actual preservatives used, but Dr. Coutts is pursuing this investigation, and has already examined many of the substances in common use for preserving articles of food, and has found that several of these contained very material proportions of arsenic, as one naturally expected they would. In borax got from a grocer as much as 1-28th to 1-23rd of a grain of arsenic per pound was found.

5318. (Chairman.) What special measures in connection with arsenic in beer appear to you to be indicated by the present outbreak?—Firstly, that sulphuric acid manufacturers should send with each invoice of sulphuric acid an approximate statement of the amount of arsenic contained in it, the amount of arsenic being also stated on the label, or its absence guaranteed. Secondly, that glucose or invert sugar manufacturers, or any other manufacturers using sulphuric acid in the preparation of food, should use only sulphuric acid free from arsenic in the preparation of these food articles, any infringement being liable to severe penalty. Thirdly, that maltsters should guarantee their malt to be free from appreciable amounts of arsenic. Fourthly, that brewers should be made responsible for the purity of the beer manufactured by them, and make it a practice to have their brewing material regularly analysed for arsenic in the course of the analyses to which these materials are submitted for other purposes. That any new kind of material introduced in brewing should be submitted to a complete quantitative analysis by chemists of the highest standing before the use of such a substance is allowed. Fifthly, that retailers should not be permitted to add any substance to the beer they sell (other than such material as may be supplied to them by the brewer from whom the beer has been obtained); any addition being considered fraudulent. Sixthly, that some reliable method of analysis should be recognised officially by which the detection of any amount of arsenic equal to or exceeding 1-100th grain (or 1-200th grain) per gallon may be easily made. Seventhly, that any beer in which the presence of arsenic had been revealed by this method should be condemned as unfit for consumption. Eighthly, that the importance of not using chemicals containing arsenic (sulphuric acid, hydrochloric acid, carbonate of soda) for the purpose of cleaning bottles, etc., should be made generally known, as well as the necessity of very thorough washing with water after the use of any chemical substance for that purpose.

5319. Do you suggest any machinery for carrying out the suggestions you have made?—Of course, I am not an expert in public health administration, or in legal matters, and any suggestions I may make, I make with a certain amount of hesitation. Some Government control over the manufacture of artificial articles of food seems to me to be necessary. This might be obtained by a system of registration and licence, no licence being given by the Government through the local sanitary authorities to would-be manufacturers who personally or through a responsible agent did not show a reasonable knowledge of the processes they intended using, and of their dangers to public health. Secondly, the public health authorities (central or local) might issue schedules indicating the substances which are liable to affect public health, the tests necessary to discover them and recognised by the

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Arsenic in
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Amount of
arsenic in
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Standard
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authorities, the methods and tests to be employed being described minutely. Such schedules would naturally be liable to periodical revision.

5320. (*Mr. Cosmo Bonsor.*) By the Government you probably meant the local authority?—The Local Government Board through the local health authorities.

5321. How far would you carry that. It occurs to me that if it was carried very far it might prevent a retailing druggist from selling a summer drink to people, a thing which is done a great deal?—I am not an administrator, and this is a detail upon which men acquainted with the administration of the law could advise better than I could. In the case of Bostock's, for instance, nobody could accuse them of having been criminal in intention, but, at the same time, they were absolutely without any knowledge of the importance of securing sulphuric acid free from arsenic, went on using

it for some considerable length of time, and might have done a great deal more damage if their mistake had remained undiscovered.

5322. Do you think that all manufacturers should have a knowledge of chemistry?—No, but if the manufacturer knew chemistry, he might be expected to know the processes he intends using, if he only finds the capital he should employ a competent chemist or technical expert who should be able to give a guarantee to the Local Government Board that the processes which are used under his direction are of such a nature that there is no possibility of the introduction of poison into the food articles he manufactures.

5323. (*Sir William Church.*) Perhaps you would like these only to be considered as suggestions?—Only as suggestions.

Mr. WILLIAM MARSHALL, Public Analyst to the Borough of Hyde, called; and Examined.

Mr.
W. Marshall.

Prosecution
at Rochdale.

5324. (*Chairman.*) You wish to make a statement as to some information we were wishing to obtain?—Yes. As Public Analyst for Hyde I was present at the Rochdale case, which was mentioned yesterday. The case was brought by the County Authorities; 1-5th of a grain of arsenic was said to be present. The case was dismissed not on the question of the arsenic at all, but on a technical point, viz., the division of the sample. The County analyst found 1-5th of a grain, Somerset House found 1-30th of a grain, I found 1-30th of a grain, another analyst found 1-15th of a grain, and another 1-40th of a grain; but the 1-40th of a grain was As, elementary arsenic, whereas in As_2O_3 it would have been 1-30th.

5325. (*Chairman.*) That reduces the discrepancy very much from what was put before us yesterday?—Yes. Somerset House found 1-50th of a grain As_2O_3 .

5326. (*Dr. Whitelegge.*) There was a further result of 1-5th?—The county analyst gave the amount as 1-5th and the prosecution was taken on the 1-5th.

5327. Then the discrepancy remains?—Yes; the case was dismissed on the question of the division of the magist sample, and the magistrates gave no opinion about the decision arsenic at all.

5328. (*Chairman.*) The question of the credibility of the tests for arsenic did not come before the magistrates?—All the evidence was taken on the method of testing, but they decided the point on the division of the sample. The county analyst used Berzelius's method, but I do not know what method the Somerset House authorities used. I used a modified form of the Marsh test.

Mr. HENRY SPENCER, called; and Examined.

Mr.
H. Spencer.

Duties of
Officers of
Excise in
breweries.

5329. (*Chairman.*) You are collector of Inland Revenue for Manchester collection?—That is so.

5330. You have had occasion to visit various breweries officially in Manchester?—I have.

5331. Will you let the Commission have the benefit of any information you can give with respect to the subject of our enquiry?—The Commissioners of Inland Revenue desire me to appear before you to give evidence touching your inquiry. The object sought by the proposed evidence is, I believe, to assist the Commission to a clear understanding of the nature of that part of the ordinary duties of officers of Inland Revenue which is connected with surveying breweries. It will be my endeavour to illustrate the character and extent of the supervision exercised by the officers at breweries by referring to Inland Revenue books of account relating to two breweries selected for the purpose from forty breweries situate in Manchester collection. As the illustration of this supervision proceeds the stages will be indicated by which control is maintained, with the view of safeguarding the Revenue. The importance of this control is at once apparent from the consideration that the beer manufactured in the United Kingdom contributes, in round figures, £1,000,000 per month to the Imperial Exchequer. It is desirable at the outset to emphasise the fact that the business of a Revenue official at a brewery is not so much to impose any restriction upon the nature, extent, and proportions of materials used in making beer as to see to it that the beer duty is correctly levied. To secure this object the officer's visits to the brewery are timed to observe and take note of certain operations and to check the traders' accounts at important stages of the manufacture. The brewer enjoys the maximum of freedom in the selection and manipulation of his brewing materials, and none of his vessels or stores are placed under Revenue lock as in the case of distilleries. The brewer must, however, conform to certain regulations in order that the officer may be able to follow the course of brewing—viz., he must give 24 hours' notice of his intention to mash malt or corn and to dissolve sugar, and the quantity or weight, and a description of the materials to be used must be entered in a brewing book provided by the Revenue authorities for the purpose, at least 24 hours before the said materials are timed to be

used. That is the brewing book to which I refer. (*Book shown.*) I thought perhaps it would be interesting to observe the instructions given to brewers and to note the method of entering their materials, and so forth.

5332. (*Mr. Cosmo Bonsor.*) I presume these instructions are absolutely in accordance with the 1880 Act?—Yes, and the amending Acts, a list of which is given on the first page. It is also required that all the worts must be removed in the prescribed order of brewing from vessel to vessel, and be finally placed into collecting or fermenting vessels, and must remain there until the officer has taken an account, or until after the expiration of 12 hours. The brewer must also enter into the aforesaid brewing book an account of the worts collected for Revenue charge. This account must include the whole of the worts produced from the entered brewing, and must show the dip of the gauged vessel (in order that the bulk quantity may be ascertained) and the original gravity of the worts—that is, the true gravity before fermentation sets in. As soon as his other duties permit, the officer checks this account, and day by day so long as the beer remains in the fermenting vessels he satisfies himself that it is not fraudulently disturbed. The brewer is practically at liberty to remove the beer from the fermenting vessel as soon as he pleases after the Revenue account has been taken by the officer. From the fermenting vessel the beer is usually run down into the cellar, where no further Revenue account is obtained of the beer unless as a check upon priming operations or should there be any reason to suspect fraud. At many breweries sugar solution—that is, sugar dissolved in water to which no yeast has been added—is prepared at a gravity not exceeding 1,150 degrees to be used as priming. Priming is usually added to beer in casks, but also may be and frequently is added to beer in the racking vessels. From these racking vessels the beer when well mixed with the priming is racked off into casks. Under regulations a quantity of sugar solution may be added to beer, not to exceed half a gallon of the solution to 36 gallons of beer, or if added to quantities of beer in bulk in racking vessels $\frac{1}{2}$ per cent. of solution may be used. In practice the quantity of solution added to the finished beer varies

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Mr.
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but it must be kept within the legal limit above described. The officer occasionally checks priming operations, and casks which have been primed are required to be retained in stock for one hour so as to afford the officer an opportunity to sample for analysis should there be reason to suspect that the limitations in the use of solution have been exceeded. The process of priming gives a briskness to the finished article, which is supposed to add to its refreshing qualities. Although, as stated, no official account is recorded beyond that relating to priming operations of the proceedings conducted in beer cellars and in stores, the officer keeps every room, place, cellar, and vessel under close observation, and the least indication of fraudulent intent upon the Revenue would become the subject of immediate investigation and report to his superior officer.

5333. (Chairman.) With regard to priming, when priming is put into the cask is the whole cask stirred after the priming is put in?—It is.

5334. With a special stirrer?—The usual practice is to withdraw a small quantity of beer from the full cask which has come from the racking vessel, then to pour in the priming, stir up with a stick, and bung up, and then to roll the cask away.

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5335. Your officer's test is made after it has been thoroughly stirred?—Yes. I have an illustration of that.

5336. (Mr. Cosmo Bonser.) Would you kindly tell me where the notice of priming is given in the brewing book?—There is no printed title to apply especially to the priming, but the brewers write on the line that they are going to use so much priming for so many casks.

5337. Is priming allowed under any of the Acts of Parliament mentioned in the brewing book?—Perhaps not, specifically. It would be treated more under the mixing regulations—the regulations which permit one brewing to be mixed with another.

5338. You are aware of the 27th Clause of the 1880 Inland Revenue Act?—Yes.

5339. "If any brewer shall conceal any worts or beer so as to prevent any officer from taking an account of them, or shall mix any sugar with any worts or beer so as to increase the quantity or gravity thereof after an account of such worts or beer has been taken by an officer." I take it that in priming the quantity or gravity of the worts or beer has been taken by the officer; the beer is complete as far as revenue purpose is concerned?—Yes.

5340. And the priming is what is called "sugar" under the definition of the Act?—Yes.

5341. Consequently, "If any brewer . . . shall mix any sugar with any worts or beer so as to increase the quantity or gravity thereof after an account of such worts or beer has been taken by an officer and the duty has been charged thereon, he shall for every such offence incur a fine of £100, and the worts or beer in respect of which the offence is committed, together with the vessels containing the same, shall be forfeited." Has that clause been repealed?—I do not remember that it has.

5342. As a matter of fact, I believe that brewers are allowed to prime under what is called an excise regulation?—Yes.

5343. They are allowed to prime up to a quantity?—Half a gallon to the barrel.

5344. At a gravity of 1,150?—Not exceeding 1,150.

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5345. But as far as you know, there is no statutory permission?—I am not aware that there is a Statute specifically referring to priming.

5346. The Commissioners of Inland Revenue or of the Treasury have allowed brewers to prime under special regulations of their own for which no doubt they have powers?—They are allowed to prime on the instructions from the Commissioners.

5347. In the brewing book that is provided to a brewer there is practically no printed form of notice of priming?—No, there is not. He writes on the line, as I explained just now.

5348. You have been good enough to give us the practice that has been general since 1880 in breweries by the Inland Revenue officers. Has any change been made since this unfortunate epidemic occurred in Manchester and Salford, any change in the regulations or any further instructions given?—No change in the regulations has been made.

5349. I presume it was reported by the Inland 4576.

Revenue officers to Somerset House?—Yes; considerable anxiety was expressed by the Commissioners to know what was being done. I was called upon to report as fully as I possibly could the whole of the facts of the case.

5350. You are aware of a clause, I suppose, in the 1888 Act which gives powers to the Inland Revenue to stop any deleterious or noxious substance going into a brewery?—Yes.

5351. Have any instructions been given you under that clause?—Instructions would be issued immediately after the passing of the Act; that is the usual practice. When an Act of Parliament is passed we receive instructions from the Board as to the way in which the provisions of the Act should be enforced, and though I do not remember for the moment, I have not the least doubt that similar instructions were issued when that Act became law.

5352. When it came to the knowledge of the Inland Revenue that a noxious substance in the state of arsenic was going into the beer, did you take any action under the powers of that Act?—We were like everybody else; we were very much astonished to hear that arsenic had been found in the beer. It did not occur to me as collector here to ask that any steps should be taken.

5353. I can quite understand it. I am not censuring in any way?—The clause to which you refer as to any substance or liquor which is capable of being used in the manufacture and so on which may affect prejudicially the interests of the Revenue—

5354. There is more: "Any substance or liquor of a noxious or detrimental nature, or—" I am perfectly aware why this clause was passed; it was for the purpose of stopping the saccharin used in brewing: practically for the protection of the Revenue?—I have a note to that effect. I intended to mention it if my attention had not been drawn to the matter. The assumption is that the Department would know of these noxious materials. If we knew that a brewer along with his malt and sugar was going to add something that was considered objectionable—

5355. Such as arsenic?—No man in his senses would do that. If we saw he was about to add something we considered would be deleterious, of course it would then become our duty to take cognisance of the fact and report the matter for instructions.

5356. I think you have powers to take samples of any material used in brewing for the purposes of analysis?—Yes.

5357. At any time or any hour?—Yes.

5358. And practically your officers are continually in supervision of a brewery?—Yes, at the large ones.

5359. Have you any suggestion to make to the Commission as to how that supervision could be better used for the protection of the public? Not for the protection of the Revenue, but for the protection of the public from a similar outbreak?—We exist solely for the security of the Revenue, and I am not aware that we could do anything more than that. We find it to be sufficiently arduous and exacting to secure the Revenue. I am not prepared to make any suggestion as to throwing upon the Department the responsibility for the purity of the article; those impurities having got in accidentally.

5360. I should like to ask one or two questions as regards what happened when the beer was incriminated from having arsenic in it. The brewers, I understand, asked to get a drawback on the beer that had been duty on brewed. Had you powers without going to London to give that drawback?—No.

5361. You had to get a special permit from the Board of Inland Revenue in London?—Yes.

5362. I believe in nearly every instance you gave a drawback to beer that had not left the premises of the brewer?—There have been some, perhaps, nine or ten, cases settled—others no doubt are pending—wherein the brewer has been repaid the duty on the beer that had not left his premises.

5363. Was there any delay in finding the quantity of beer upon which the drawback was claimed?—No delay. That rested with the local officials. I made special arrangements with the various supervisors and officers to take the accounts immediately. I remember in one case a very zealous supervisor with one or two officers were at work until 10 or 11 on Saturday night, and spent six or seven hours there on Sunday to expedite the account.

Mr.
H. Spencer.
30 Mar. 1901.

No action
taken by
I. R. under
1888 Act
in view of
epidemic.

Excise
officers have
power to take
samples of
brewing
materials.

Excise
officers' duties to
secure the
revenue.

Principle
of granting
of drawback
contaminated
beer.

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5364. To get the quantity and sample for the purpose of providing the specific gravity for repaying the duty paid?—It was not then decided whether the duty would be repaid; that depended entirely upon the action of the Commissioners, but it was our duty locally to secure the accounts so that, if upon consideration the Commissioners thought proper to repay the duty, it could be done. The great concern of the trade was to get empty casks into which to put their new beer. It was for that reason, more than to get the duty back, that I made these special arrangements in order that their business might not be interfered with unduly.

5365. Has all the beer been destroyed now or do your officers know of any still undestroyed?—We have had no knowledge whatever of the beer in the cellars of the publicans, but the whole of the beer that was supposed to be contaminated and which the brewers presented to us to take account was taken an account of immediately, within two or three weeks perhaps.

5366. And has it been destroyed under the supervision of the officers?—Yes; the whole of it was destroyed under the supervision of the officers immediately after each account was taken.

5367. What happened about the beer which was in the publicans' cellars?—We have no cognisance of that.

Contaminated beer which had left brewery not considered admissible for rebate.

5368. Not if it was brought back to the brewery?—No. Beer once having left the brewery is inadmissible for repayment of duty, whatever may be wrong with it. Beer that has gone sour, for instance, or that has spoiled from any other cause, if it has once left the brewery, is not admissible for repayment of the duty.

5369. Under what Act of Parliament?—I cannot tell you at the moment, but it is so.

5370. Under an Excise regulation possibly, but not under an Act of Parliament?—The point has been considered by the Commissioners, and the decision has been arrived at that the beer which had left the brewery premises is not admissible for repayment.

Rebate granted on exported beer.

5371. Beer which leaves the brewery premises to go abroad to be shipped to a foreign port is admissible for drawback?—Certainly.

5372. And whether it goes from a brewery or from the public-houses or from an agent of the brewery, it is still admissible for drawback?—If the beer can be traced, that is, the brewing can be traced, and we satisfy ourselves as to the original gravity and so forth, we can.

5373. I do not think there is anything about satisfying yourself if beer is exported from the United Kingdom. It can claim a drawback on the specific gravity?—True. Samples are taken at the port of exportation, and these are submitted to the analyst, and the original gravity is determined. But the brewer declares.

5374. The brewer as a rule is the exporter, but it is not absolutely necessary. There are agents who do export beer and very likely get a declaration from the brewer?—The brewer makes a declaration, and sends it on to the shipping agent.

5375. The incriminated beer that was delivered to a public-house or the agent of a brewer might have been shipped abroad and the brewer could make the declaration; why should not it have a drawback if it was shipped?—In case of doubt of that kind we should submit it to the Commissioners for instructions.

5376. But the Commissioners have ruled that beer is outside the drawback?—That which has been to the publican's cellars and has been returned. I am not aware that a decision has been arrived at on the point as you put it as to beer exported.

5377. It was not exported, but what I was asking you was, supposing that beer, instead of being returned to the brewery, had been sent on board a ship it would have been liable for drawback, but because it was returned to the brewery to be destroyed it was not liable to drawback?—It is liable for drawback simply because it leaves the United Kingdom.

5378. (Chairman.) But if it left the United Kingdom in a ship, and was poured into the sea three miles out, would it get the drawback?—I cannot say what we should do under such circumstances.

5379. I think it is clear that if an owner of a tied house or a publican had intimated that he was going to ship away from the United Kingdom he would have got the drawback?—If he had stated that he wanted to

ship it three miles out to sea, and then turn it into the sea, I think we should have hesitated as to repaying the duty.

5380. That is to say, unless he shipped it to some foreign place, to poison people there, he would not get the drawback?—As to the question of poison, of course we did not know it was there for a considerable time.

5381. But when this question was raised it was already known to be poisonous beer?—Yes.

5382. This does not commit anybody, but I understand that according to the action of the regulations that were insisted upon at the time by the Commissioners, the publican might have shipped and sold to foreign parts, and would have got the drawback?—I am not so sure about that. If our suspicions had been raised, I think the Commissioners would have hesitated before paying the drawback. If there is anything to suggest a suspicion that the exportation is not bona fide for a foreign country, any officer with a head on his shoulders would at once take steps to stop the fraud, as I should consider it.

5383. (Mr. Cosmo Benson.) Fraud on whom?—On the revenue.

5384. Why on the revenue? It has received the tax?—For obtaining the drawback improperly.

5385. But the brewer has paid the tax. It cannot be any fraud if he is not going to sell it afterwards?—His Lordship is speaking of a hypothetical case, I suppose, where beer is sent away and proves to be poisoned beer.

5386. (Chairman.) It does seem that as drawback is admissible in certain defined cases, in this unprecedented case which might be classed technically with those in which drawback was allowed before, the drawback could here also be allowed on reconsideration. Perhaps on appeal to the Commissioners the would allow the drawback?—Any case of doubt would be submitted to them. We should not entertain a case of drawback unless it was perfectly clear and straightforward. The least doubt on any point we should, according to our instructions, submit for the Commissioners to decide upon.

5387. (Mr. Cosmo Benson.) It has been decided by the Commissioners that no drawback is to be allowed on beer in a licensed victualler's cellar?—I think I saw it in a newspaper report, but I do not know officially that the point has been brought to the attention of the Commissioners by those interested in brewing, and that they have decided not to allow repayment.

5388. You have no instructions upon it?—No.

5389. (Chairman.) Has any request come to you and been passed on by you to the Commissioners for drawback in respect of the recent epidemic?—A considerable number of applications went up to the Commissioners, some of which have been decided, as I have said, but, so far as I am aware, in every case the application related to beer which had not left the premises.

5390. And you do not know of cases in which the beer had left the premises and drawback asked for it?—I do not know.

5391. (Mr. Cosmo Benson.) With regard to the question of brewing, is it part of the duty of the Excise officers to see that all beer, when it is collected in a vessel, goes through the process of fermentation?—No.

5392. As long as they collect the revenue, they are satisfied?—That is so. We are not there to see that the wort is fermented, that is, that every portion has yeast added to it. They simply bring their wort to charge, whether in the form of solution or in any other form, and we take the account when it is collected in the proper vessel.

5393. So that it is possible that sugar might be added to fermented beer having paid the revenue as beer brewed?—That is so; that is a common practice.

5394. Is it a common practice in this particular district?—Do you mean the use of solution?

5395. What I call a sugar solution which has not fermented?—I think it is common all over the North of England, so far as my experience goes.

5396. That is, that an unfermented wort is added to a fermented wort to complete the gyle of beer?—That is so.

5397. It is done under two declarations?—As you are

Mr.
H. Spe.
30 Mar.

Excise
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Brewer
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Mr. Spencer. aware, the sugar solution is not capable of fermentation.

5398. Unless yeast is added. Is it allowed as a "brewing"?—Technically it is called a brewing.

5399. Under the Act?—Presumably so.

5400. I should like to know what clause. Why I am asking you these questions is that the Excise authorities seem to me to have been so very strict as regards giving a drawback on beer which was poisoned, and allowing that beer to hang about, it may be, to the prejudice of the public, and yet when it is a question of revenue they seem to go outside their Act of Parliament?—I think you cannot fairly hold the Commissioners responsible for holding the beer about which was poisoned. As I have tried to explain to you, I personally adopted the most prompt measures to take an account in the breweries in order that the beer might be destroyed at once.

5401. But surely the beer in the publican's cellar was infinitely more dangerous than in the breweries?—That did not come within our cognisance; we have nothing to do with it when it leaves the brewery; we should have required a staff 200 or 300 per cent. greater.

5402. You do work in the publicans' cellar?—For certain purposes.

5403. To find if it is diluted with sugar and water, in order to prosecute?—Yes.

5404. If it was a question of the public health, and not a question of the revenue, you do not act?—It is not defined that we are custodians of the public health. We are employed for financial purposes.

5405. And to prevent deleterious and noxious substances entering?—When these ingredients are presented to us in brewing.

5406. (Dr. Whitelegge.) Are your instructions written or printed?—Printed. I receive a good many written instructions, but those that are issued for the guidance of the department generally are printed in the form of what we technically call General Orders. But in specific cases, written instructions are sent for guidance.

5407. Do any of those instructions, either general or specific, turn upon the question of damage to the public health in the ingredients used for brewing, or are they solely concerned, so far as the section of the 1888 Act is concerned, with Excise questions?—So far as I can recall, they are confined entirely to the Excise aspect of the question.

5408. There is no instruction suggesting that you should send samples in the event of any supposed danger to health in any ingredient found in the brewery?—In the matter of samples we are left almost entirely to our own discretion. If we knew that there was something wrong in the beer, we would send up a sample.

5409. Has that been done in any instance in your knowledge on the score of danger to the public health?—No; I do not know that it has. We have had no reason to suppose that there has been any mischief of that kind. The brewers are usually careful in their selection of materials to get a wholesome article, so that the matter has never been brought to our notice specifically.

5410. Does it practically come within your survey as a matter of instruction to see if the Bostock sugar is in use in a brewery?—No.

5411. If you found a sample of sugar in a brewery which you believed to be Bostock's, at the present day, what steps would you take?—If I as an officer were to find a sample, I should at once send it up to the Commissioners, and allow them to decide what should be done in the matter.

5412. Is that under instructions?—No.

5413. As a matter of common-sense?—Precisely. We are not tied down, although we are credited with being so, with red tape. We are expected to use our judgment and our common-sense in any difficulty which may arise.

5414. You know it has been suggested that malt often contains arsenic?—Yes.

5415. Do you at the present time take any action in what respect?—None whatever. You mean as to ascertaining the purity of the malt—freedom from taint.

5416. Yes, and ascertaining whether the brewer has taken any precautions to guard himself against arsenicated malt?—No. That does not come within the range of our instructions.

5417. Do you send samples from time to time of all the various brewing ingredients?—Yes.

5418. (Chairman.) Do you analyse yourself here or by your own officers?—No; we send to London to the Government laboratory.

5419. Under Dr. Thorpe?—Yes.

5420. (Dr. Whitelegge.) I have a long list here from the evidence given before the Departmental Committee on Beer Materials—a long list extending to two pages—of various substances used. May I take it that you are empowered and instructed to take samples from time to time, as you find occasion to do so, of all these materials?—Are they brewing materials?

5421. Materials that go into beer. Do you send samples only of malt and malt substitutes?—We send samples of everything that is used in the brewing which is supposed to give saccharine value to the wort.

5422. That answers my question. You would not be concerned with such things as preservatives or colouring ingredients?—The colouring matter—that is the caramel—we have taken account of on account of its sugar value.

5423. You send samples from time to time of caramel?—If we have occasion to do so. The practice is for the brewer to enter the weight of the caramel in the brewing book, and we accept that and find its sugar value at the end of the month.

5424. But the instructions do not carry you further than this, that from time to time samples are to be taken and forwarded to Somerset House of any material that is likely to affect the Revenue?—The whole object of sampling by the Revenue officers is to ensure that we get the full brewing value out of the materials, and that nothing is used which adds saccharine to the wort, the value of which cannot be ascertained by the saccharometer. The special substance, saccharin, for instance, has already been referred to. That is one of the ingredients that is prohibited, the only one, I think, which has been prohibited since 1888, when the Act was passed.

5425. Do you know on what ground saccharin was prohibited?—Because we cannot ascertain its brewing value.

5426. Not because it is supposed to be prejudicial to health?—Not on that account.

5427. (Chairman.) Does the saccharometer measure saccharin?—No.

5428. Saccharin is a chemical discovery of some 10 or 15 years?—Yes.

5429. But the saccharometer takes no cognisance of that?—It does not.

5430. Does the saccharometer ordinarily indicate by gravity?—That is so.

5431. Not by the optical property?—By gravity solely.

5432. Is the optical property used at all in your tests?—We do not as officers. Our only means of ascertaining the gravity is by the use of the authorised saccharometer.

5433. (Dr. Whitelegge.) May I take it that the central authorities know of all the ingredients of beer?—Do you refer to the ingredients mentioned in this book, maize grits, rice, and the other things?

5434. (Mr. Cosmo Benson.) Everything except the antiseptics?—None whatever of the preservatives.

5435. (Dr. Whitelegge.) They have no record of that?—None whatever.

5436. They have no record of the detail of the ingredients going into beer?—Further than is necessary for revenue purposes.

5437. Grouped, that is, under broad headings?—Broad headings, as detailed here.

5438. Would it be possible for the Inland Revenue to obtain information of every ingredient going into every brewing of beer?—I am not in a position to say.

5439. (Sir William Church.) Could you tell me how the brewers got information that the Commissioners would not allow any drawback upon beer that had left the breweries? We have had several pieces of evidence before us, and when we asked why they had not made an application for a drawback, they said they were told it was no use?—For some years there have been occasional instances where repayment of the duty has been claimed on beer in consequence of its having become

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Selection of samples sent to Government laboratory governed by revenue considerations.

Prohibition of saccharin.

A. M. J. J.

Extent of information as regards brewing materials required by I. R.

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Rebate
refused on
beer which
had left
brewery.

sour or unfit for drinking from any cause, and when such beer has not left the brewery premises the repayment is allowed; but the brewer has to make a declaration that it has not left the brewery premises, and the brewers being accustomed to this for a number of years, I presume would naturally infer, having the practice of spoilt beer before them, that the beer in the publicans' cellars would not be entertained for any repayment. It did not occur to me at the moment when Mr. Bonsor was asking me questions, but I may say that immediately it was found by the brewers locally that there was something wrong with their beer, several of them came to see me to ask for assistance in the matter, and in the course of conversation I told two or three of them, and no doubt the matter would get noised abroad, that I was of opinion that the Commissioners would not entertain an application for repayment of duty on the beer which was in the publicans' cellars. In one case I remember a certain number of casks were mentioned, but perhaps I had better not repeat the figures; and I remarked: "You had better let that go down the drain at once, as the Commissioners will not pay you." I believe the firm acted on the suggestion, and destroyed the beer at once, in order that they might get the casks back to be filled with wholesome beer.

5440. So far as you are aware, there has been no formal application made to the Commissioners by any brewer?—I think I have good reason for saying that representatives of the brewers approached the Commissioners in London directly, and did not go through me. I simply heard that; I have no official knowledge.

Decrease in
consumption
of beer in
Manchester
in 1900.

5441. (Mr. Cosmo Bonsor.) Could you tell us if there was any great falling off in the consumption of beer between July and November when it became apparent?—I thought perhaps something might arise on that point, and for my own satisfaction primarily I caused

an abstract to be made, which I will read to you. This refers to Manchester collection.

5442. Does that include Salford?—Yes. I commence with October, 1899. The mischief commenced in November, 1900. October, 1899, 4,696,932 gallons; October, 1900, 4,368,473 gallons—a decrease of 328,000. I think we know why that decrease arose. November, 1899, 4,934,747; November, 1900, when the mischief came to light, 3,955,200—a decrease of 979,000. December, when brewers were busy restocking their cellars, 1899, 4,482,473; December, 1900, 4,463,000 odd—a decrease of only 19,000. In January and February it becomes natural again, nearly 4,000,000.

5443. (Chairman.) The decrease in October and November, do you attribute that to the illness caused?—I have no specific reason, only the suggestion of the figures. I have made no inquiry.

5444. (Dr. Whitelegge.) The figures relate to the beer brewed?—Yes, the bulk gallons.

5445. Does it take any account, or is it affected by the amount destroyed?—I think so, in December. I suggested, when reading the figures, that the comparison was good presumably because the brewers were restocking the cellars to make up for the destroyed beer.

5446. (Mr. Cosmo Bonsor.) We had evidence from one brewer there was a good deal of dissatisfaction with the beers as early as August, and that people had given up drinking beer, I think the expression was. Was there any falling off in August or September that the Excise would notice?—I did not go so far back. For my purpose I thought October would be early enough.

5447. (Chairman.) You were going to give us the outline of the nature of an officer's duty at a brewery?—Shall I go on with that? I have described the breweries as X and Y, and it would be more satisfactory if you would take the evidence confidentially.

ELEVENTH DAY

AT WESTMINSTER PALACE HOTEL.

Friday, 26th April, 1901.

PRESENT:

The Right Hon. LORD KELVIN (Chairman).

The Right Hon. Sir WILLIAM HART-DYKE.
Sir WILLIAM CHURCH.
Professor THORPE.

Mr. COSMO BONSOR.
Dr. WHITELEGGE.

Dr. BUCHANAN, Secretary.

Mr. HENRY A. TAYLOR, called; and Examined.

Mr. H. A.
Taylor.

5448. (Chairman.) You are maltsters of Ware?—Yes, and Sawbridgeworth, which is our business address.

5449. You are a practical maltster, and acquainted with the system of malting practised in a considerable part of England?—I have been a maltster 25 years.

5450. And where in particular have you most experience?—At Sawbridgeworth and Bishop's Stortford in Hertfordshire.

Process of
malting on
kilo floor
described.

5451. The process adopted nearly everywhere in your experience is malting on the floor, is not it?—Yes. In a few isolated cases pneumatic malting is adopted.

5452. Will you briefly describe the process of malting on the floor, and we shall afterwards hear about the pneumatic malting?—In the floor process the barley, after being received from the farmer, is sweated or slightly dried on the kilns. After that it is put into the barley lofts and then shot into screens to remove all imperfections in the way of light corn, etc. It is then put into the cisterns for a certain number of hours; after that it is moved on to working floors for germination, and when sufficiently converted is loaded on the kilns.

5453. In the first drying is it exposed to the fumes of the fire?—Yes.

5454. Coming through fine holes in the floor?—Through an air shaft generally.

5455. (Mr. Cosmo Bonsor.) On wire?—Wires too.

5456. (Chairman.) An air shaft coming under the wires?—Yes.

5457. And the grain is placed on wires?—Yes, on wires or tiles; in some cases perforated tiles.

5458. Perforated earthenware tiles?—Yes.

5459. In other cases on wires?—Yes, iron wires.

5460. Is that wire cloth?—Yes, wire netting, or in some places wedged-shape bars.

5461. When the floor is perforated tiles, are they very fine perforations?—Yes, very fine perforations.

5462. With regard to the screening, that is done after the first drying?—The screening of malt previous to delivery do you mean?

5463. The screening you have already spoken of?—That is the screening of barley.

5464. Before it is malted?—Before it is put in the cisterns.

Mr. E.
Taylor.

Screening
barley.

H. A. Taylor. 5465. Then you have one process of screening before the malting commences?—Yes.

pr. 1901. 5466. After that?—It is then put into cisterns to steep, and then after a certain number of hours it is thrown out on the working floors to germinate, and when sufficiently converted, it is laid on the kilns, where it is kept for two, or three, or four days according to the capacity of the kilns and mode of working.

5467-9. It is first of all soaked in the cistern for some hours, and becomes I suppose slightly swelled?—Yes.

5470. How long is it undergoing the germinating process?—It depends on the weather, from eight to fourteen days.

5471. During that time the rootlets show themselves outside?—Yes.

5472. After the germination, what is the next step?—It is loaded on to the kilns.

perature
malting. 5473. How much heat does it get on the kiln?—It is a gradual process. We start at 90°, and it depends on the character of the malt, what it is meant for, how high we dry it. With pale malt we go up to 180° or 220°, and very high dried malt to 220°, or 250°.

5474. The rootlets are on the grain during all this time?—Yes.

ration of
dust. 5475. Do they break off?—They do a little in turning. It is turned several times on the kilns.

5476. Is a good deal of dust left on the kiln after that turning?—Yes; some percolates through the wire flooring a little.

5477. Have you ever examined the dust on the floor due to the turning irrespective of screening and before screening?—Do you mean chemically?

5478. The dust is swept away from time to time?—No, some of it percolates through, and when there is sufficient there to remove in any quantity it is taken out.

5479. From where?—From under the wire.

5480. Swept out?—Yes, taken out altogether, cleaned.

5481. I suppose that consists chiefly of radicles?—And the chafings off the malt.

5482. Have you ever examined that dust?—No.

5483. That dust will be liable to have any incrustation that may come from the fumes?—Yes; a certain amount is collected, no doubt.

5484. So that if there was arsenic in the fumes, it would be found in that dust?—I should say a certain proportion, yes.

5485. That has not hitherto been examined chemically?—No; I do not think so.

5486. What is done with the dust?—It is sold for manure solely, as far as my experience goes.

5487. Sent away dry in bags?—Yes, and put on the land.

5488. We have got as far as removal from the drying floor. The kiln process you have described would not be called roasting, would it?—No.

5489. That never blackens the malt?—No.

5490. So that whether it is for pale beers, or ale, or for stout, dark or black beers, the process so far is the same?—Yes.

5491. Is the palest beer made from malt not so highly dried?—Yes.

5492. And less pale beer from more highly dried?—Yes.

k malt, 5493. But none of this drying is sufficient to make black stout?—No; black malt is made in cylinders.

5494. What is the next process after removal from the floor?—A second screening, and sometimes a third one.

ming of 5495. How is that screening conducted?—In several ways. One way is simply through a plain screen where the rootlets drop through, and another way is to brush it and to take the thin corn out, and that kind of thing.

5496. What kind of brushes are used?—Revolving brushes.

5497. Of what kind of material—wire?—Wire, yes.

5498. Always wire?—No; bristles, as well as wire. Brushing is very little resorted to.

5499. The screening is generally sufficient?—Generally considered sufficient.

5500. What is the screening—slaking it?—In some

cases. In other cases it is simply thrown in a hopper and allowed to run down a flat screen.

5501. What is the screen exactly?—It is a wire screen, made something like the wire floor, only not so stout.

5502. And then falling down on the floor shakes the dust sufficiently off?—After falling down the screen the dust goes through the wire, and the malt comes out at the foot of the screen.

5503. If it merely falls on the screen, is there anything to take the incrustation off the malt that may be on it?—I do not quite follow you.

5504. Is the falling down in the screen sufficient to shake off any incrustation there may be?—No, it merely takes away the radicles and fine dust.

5505. Sometimes I understand it is shaken backwards and forwards?—Yes, that is another mode.

5506. What is the object of that?—It does its work rather better perhaps.

5507. Makes the one grain rub on the other?—It gets the malt rather cleaner.

5508. What is the chief thing removed in that process?—The rootlets.

5509. Is there much done also in removing incrustation?—No, I think not in the ordinary screening. If you brush malt it does undoubtedly.

5510. The brushing is not always conducted?—Very seldom resorted to.

5511. In what circumstances do you resort to brushing?—It was originally resorted to to remove the mould and other outside imperfections in malting. Of late years brewers have objected to it for a very good reason that it gives an artificial value to malt.

5512. How is that?—It makes a better appearance; it cleans it up and makes it look a better article than it is. A good many brewers object to it and rightly.

5513. Why rightly?—Because I do not think it gives the maltster who is careful a chance.

5514. Why not?—Because the man who has made mouldy malt can brush his malt and make it look as good as the man who makes it without.

5515. If it is good malt and not mouldy is there no incrustation to take off generally?—No, very little. If you brush malt you will always get something off it, however well made it is.

5516. Is there not generally some sulphur or other incrustation from the fumes which should be removed?—I think not. If malt is carefully made I do not see there can be anything.

5517. How long is the malt usually on the kilns?—From two to three or four days, it depends on the modes of drying, some people dry with fans which takes less time than the other. Other people dry simply with the gradual process, and there are various other methods. One man does it one way and one another.

5518. How long a time elapses before the germination is stopped by the kiln?—At once, it should be.

5519. The first exposure?—Yes; afterwards it is a gradual process.

5520. What fuel or fuels are used for the kilns in the maltings of which you have had practical experience?—Our own maltings only, do you mean?

5521. Or in those of which you have had experience?—In our district anthracite coal is nearly always used. Occasionally coke is used, but it does not pay in our district; we cannot use it.

5522. Is the cost of the coal in the malting process much in comparison with the whole expense?—Yes, it comes to about nowadays 1s. to 1s. 6d. a quarter.

5523. And the whole process, labour, appliances, capital on plant, etc., the total expense of the malting is what?—About 6s. to 7s. per qr. The fuel is about one-fifth.

5524. One-fifth of what?—Of the total expense of making the malt.

5525. (Sir William Hart-Dyke.) The fuel?—Yes.

5526. (Chairman.) In your total expense you reckon interest on money, building, malting floors, etc., do you?—I could hardly answer that off-hand.

5527. There is not a great expense because the wages are not large?—The wages are very large indeed.

5528. Three or four times as much as the fuel?—No, certainly not that.

Mr. H. A. Taylor.
28 Apr. 1901.

Brushing
malt.

Duration of
kilning.

Cost of
malting fuel.

Mr. H. A.
Taylor.
26 Apr. 1901.

Anthracite
containing
negligible
amount of
arsenic.

5529. Have you had any chemical analysis of the fuel?—From what we can gather from analysis the best anthracite coal contains little or no arsenic, and we are told that coke does; but personally we have no practical experience, as we use only coal.

5530. Only anthracite coal?—Yes.

5531. Have you had analyses made yourselves of the anthracite?—Yes, of the coal we use. I have one here. Here is one made from coal taken from 20 heaps. The analyst reports this: "A sample of coal received from you on April 17th has been tested for arsenic; a minute trace has been found in it which is quite negligible. You can use the coal with confidence."

5532. Are there any tests for sulphur also?—No, not that I know of. We have not tried it.

5533. Previous to last year and the scare, had you ever any test of the anthracite?—None. We have made no difference whatever in the manufacture of our malt since the Manchester scare.

5534. But you have had analyses made?—Yes, we keep taking them every day.

5535. But you never had analyses made before?—Never as to coal.

5536. Do you find the fuel varies? Do the different supplies vary from one another?—I do not think it does very much, but I do not think you can guarantee—or we are told that you cannot guarantee—coal free from arsenic, absolutely free. You can guarantee it practically free, but not absolutely free.

5537. Does your analyst state quantities of arsenic?—Yes. In this particular report I think it was 1-300th of a grain to the lb.

5538. In one specimen?—That was taken from the bulk; a piece of coal taken from 20 heaps, all smashed up together, and sent to the analyst to report on.

5539. Is that the largest quantity of arsenic that was found?—I should say not. I do not know. That is our experience.

5540. In the other reports you read "a slight trace of arsenic"?—That refers to the same coal.

5541. It was said it might be neglected. This amount you now state is how many grains?—1-300th part of a grain to the lb.

5542. Did the analyst consider that as negligible?—Yes.

5543. You do not know of any larger quantity than that having been found?—I do not know of any percentage; that is the largest we have found in our own.

5544. (Mr. Cosmo Bonser.) That is anthracite?—Yes.

5545. Have you a table of analyses that can appear with your evidence?—No.

5546. (Chairman.) You have no further result of analysis?—Not as regards coal.

5547. It would be quite practicable to obtain specimens of the dust from the different stages?—Yes.

Malt dust.

5548. In the screening the dust is carried away in a current of air, is it not?—Yes.

5549. Is it left on the floor?—It is left in the garner or malt loft.

5550. In any of your processes is the dust carried off with a stream of air?—No, only in the brewery.

5551. Since the scare have you had any analysis of the dust?—No, we have not.

Malt tested
for arsenic
by maltster.

5552. Or of the finished malt?—Yes, any amount. I will read you one of our own malt:—We had samples drawn the other day from all parts of our different bulks of malt, and sent them up to the analyst to report on them. He reported: "All these samples have been tested for arsenic by a severe form of the Marsh test. I have found no arsenic in any of them." But still for all that I do not see that we can guarantee the malt free from arsenic simply because we cannot guarantee the coal.

5553. (Sir William Hart-Dyke.) Is that from your own analyst?—Yes.

5554. (Chairman.) Have you an analyst in your factory?—Yes. We have a laboratory. But this is not from him.

5555. Is he a London analyst?—Yes, this is a London analyst.

5556. Do you put in this statement with your evi-

dence?—Yes. I have not his authority to give his name, but I would put it in.

Mr. E.
Taylor.

5557. There can be no objection to the name being given, I suppose, if you have it? We have always had the names of analysts given. He did not mark his letters "Private and Confidential," did he?—Not that I know of.

26 Apr.

5558. Then will you give the name?—Dr. Moritz.

5559. He did not find any trace of arsenic?—No trace of arsenic, and yet I say I do not think it is possible to guarantee malt absolutely free from arsenic.

5560. Have you had any other analysis of your malt?—We have them every day.

5561. By your own analyst?—Yes, and by these people, Moritz and Morris.

5562. Has a trace of arsenic been found?—We have not found any.

5563. Not in any of the analyses?—Not one.

5564. If there was arsenic at all from the fuel it would be in much larger proportion in the dust than in the grain taken away with the dust removed?—We are told so.

5565. It would be first in the dust?—We are told that it accumulates first in the dust under the kiln.

5566. It would be very advisable to have that dust looked to?—It is always removed; it never goes with the malt.

but ma
dust no
tested.

5567. It would show whether or not a coating of arsenic has been removed?—Yes.

5568. Of course it is very satisfactory that your malt has shown itself free from arsenic, and it would be important, I think, to test the dust, so as to see whether arsenic has been removed?—I think there is no doubt about it that a certain portion has.

5569. (Sir William Church.) I think I understood you to say that it did not pay to use coke in your maltings?—It does not in our district.

Coke n
used in
district

5570. Why? Is it more expensive?—Hardly more expensive, but we have a great deal of trouble to get it. We have no washed coke in our district at all, and we have to get it from the North.

5571. When you use coke you use oven coke?—Yes, but we never use it simply because of that reason. I am not setting up myself as a model of righteousness about using coke.

5572. We have had it in evidence that oven coke does not contain generally so much arsenic as gas coke, but when you use coke you use oven coke, not for that reason, but because you get it cheaper?—I should use oven coke if I could get it at all, because it would answer my purpose to do it.

5573. "Answer your purpose" means it is less expensive?—No, not always. I should say certainly it would not be less expensive for me to use oven coke, but more expensive.

5574. Why should you use it?—I might be requested to do so; I have been requested to do so by brewers.

5575. (Chairman.) Requested to use coke?—Yes, not latterly.

5576. When you have been requested you have done so?—Certainly. Some brewers used to have an idea that coke gave a better flavour to malt.

Some b
prefer
dried n

5577. Did you ever use peat for malting?—No.

5578. (Sir William Church.) It really comes to this, that the brewer objects to the maltster brushing, because an inferior sample of malt is made to appear like a good one?—Quite so. I should suggest that the brewer brushes the malt himself if he wants to.

5579. (Chairman.) Why should the brewer brush his malt?—Because arsenic is supposed to be on the outside of the grain, and if there is any left he removes it.

Brush
should
done b
brewer
by mal

5580. But your malt had none to remove?—So they say.

5581. And since the scare have brewers taken to brushing the malt?—Not that I know of.

5582. It is not their object to make the malt look better, but the object of the maltster might be so?—Yes. It is no use nowadays.

5583. (Sir William Hart-Dyke.) With regard to the screening, and the dust that proceeds therefrom after the screening process, I should like you to tell us a little more what happens to this dust?—It is sold for

H. A. feeding purposes. The rootlets taken from the malt is sold for feeding purposes.

5584. And the combings?—I mean combings.

5585. They combine the two?—Yes.

5586. The same expression defines both?—Yes.

5587. That is to say, whatever comes from the malt after this process of screening is over?—Yes. It is used for feeding.

5588. This is very largely used, is it not, in some parts of England for feeding purposes?—Yes, we sell it for nothing else. Everywhere it is the same, I believe.

5589. It is mixed for feeding purposes generally with chopped hay or chaff?—Yes, anything.

5590. It is pressed, is it not, in the form of cake usually?—I do not think so. There are malt cakes, but I do not think they are made with dust.

5591. (Chairman.) What you are speaking of now would chiefly consist of the radicles brushed off?—Yes.

5592. (Sir William Hart-Dyke.) I suppose you have not had time to read some of the evidence given already before this Commission as to the quantity of arsenic that has been found in malt dust?—I know there is a certain proportion. I can quite understand it.

5593. Have you read that in one or two instances a very large quantity has been found?—Yes. That is principally in the kiln dust, that is to say, the dust that percolates through the wire floor. I have not heard that it is contained in the malt dust itself after the process of kilning. I daresay it is.

5594. There are two kinds of dust, so to speak, that is, the kiln dust and the dust which after this process of screening is used for feeding purposes for stock?—Yes.

5595. Is this kiln dust, to your knowledge, ever used for feeding purposes?—Never; cattle will not eat it.

5596. You know of no instances in which this kiln dust has been collected and attempted to be used for feeding purposes?—No.

5597. It has not come within your knowledge?—No.

5598. It is not a practice?—No. It is sold at a much lower price, and used for manure on land solely.

5599. Personally have you had any analysis made of these combings?—No.

5600. Or dust used for feeding purposes?—No.

5601. Can you tell the Commission of any instance in which it has been analysed lately to discover whether it contains arsenic?—No, I cannot personally.

5602. All you know is what you have really read of the evidence given before this Commission with regard to the dust which has been found in the kilns?—Yes.

5603. I should like to put a general question to you with regard to your business as it is to-day. From all you know now concerning this arsenic which has been found in malt, have you any fear in carrying on your business in the future, with moderate care, including the application of analysis, as regards the immunity from poisoning in beer?—I do not see any fear myself. If good anthracite coal is used in the manufacture of malt I think there need be no fear of producing a malt practically free from arsenic. But I think some standard should be given to work to. It should be stated in some form or other what malt may contain, and how much, and let us work to that.

5604. What you mean is that it is impossible to guarantee absolute freedom from arsenic, but if you had a standard fixed, and could always produce your malt at that standard, and never exceed it, you would have absolute security?—I think so, certainly. At present it is upsetting the trade for nothing.

5605. Although you have been at the expense and trouble of analysing this coal you use from time to time, you have not personally any experience as regards the analysis of coke, oven, or gas coke?—No, we have no personal experience.

5606. All you know in regard to coke is by hearsay, or what you have read?—What our analysts tell us.

5607. (Mr. Cosmo Bonsor.) You alluded to mouldy malt: can you tell the Commission how the mould

arises on the floors?—From inferior knowledge and manufacture.

5608. Does it not arise from cracked kernels?—Certainly. Mr. H. A. Taylor.

5609. But that is not the maltsters' fault?—No, it is not.

5610. Have you had experience of malting barley which has been threshed by a flail?—Certainly.

5611. That barley would be freer from mould than barley threshed by machine?—Yes. It has been the curse of the trade all through, this threshing machine. At the present time we have broken the neck of it. We have absolutely refused to buy stuff which is broken and knocked about, and so we have made the farmer take more care and trouble about it, and now he produces an article to us which is far and away better than what it used to be.

5612. I think that foreign barley is much freer?—Yes, generally speaking, but not altogether so; it all depends on the sort you buy. There we have had exactly the same experience; until we stuck out that we would not buy barley knocked about by the machine we could not get it altered.

5613. After the barley has been on the floor, and got Sulphur mouldy, has it been the practice to your knowledge to throw sulphur on the kiln fires for the purpose of removing it?—Certainly.

5614. It is not a practice of your own?—No, it is not, but it is practised, and to no harm.

5615. It depends on the sulphur, does it not?—They guarantee the sulphur absolutely free from arsenic.

5616. Is there any practical way of telling whether malt has been dried with sulphur added to the fire or not?—There may be, I have never heard of it. I have sent up samples to be analysed in that way, but it has not been discovered.

5617-8. (Sir William Church.) When you sent those samples up for analysis did you send them up for analysis of sulphur?—No.

5619. Then they would not be examined for it?—No.

5620. It would be only examined to see if they contained a proper amount of maltose and that sort of thing, and therefore the analysis proved nothing with regard to sulphur?—No.

5621. You do not think if sulphur fumes pass through the malt there would be sulphur deposit on the malt?—I do not think so.

5622. (Mr. Cosmo Bonsor.) I was asking whether there was any practical way, independent of chemical analysis, of getting at the fact of whether sulphur had been used in the fire or not?—I think you can see it; I can see it.

5623-4. And taste it?—Yes. It brightens it. I think it is very little practised at the present day. It used to be enormously practised, but it is no good at the present day. The brewer does not buy the malt only by sight.

5625. Was the sulphur used for any other object than to kill the mould?—Yes, to give it a better appearance, to make it more marketable.

5626. But not to make it really better for brewing?—Certainly not.

5627. (Sir William Church.) It does have a beneficial effect on the malt; it brightens rather dark grain sufficiently to enable it to be used for lighter-coloured beers, does it not?—No.

5628. (Mr. Cosmo Bonsor.) Brewers object to malt being sulphured?—Certainly.

5629. If they knew it, they would not buy it?—Certainly.

5630. (Dr. Whitelegge.) Since when has it been the practice to examine sulphur for arsenic?—I do not know that it has been examined.

5631. I thought you told us the sulphur was guaranteed free from arsenic?—So it is.

5632. Can you tell us when that began?—No, we have it guaranteed ourselves from the people who use it.

5633. In the case of the sulphur you use yourselves?—Yes, as an experiment.

5634. Since when have you used anthracite?—We have never used anything else.

5635. You gave us particulars of some of the analyses at his of coal; were any of those samples of coal entirely free from maltings.

Anthracite always used

Mr. H. A. Taylor.
26 Apr. 1901.

Selection of samples of fuel for analysis.

Brown malt dried with wood.
Black malt roasted in cylinders.

Pneumatic malting described.

from arsenic?—No; I gave you a report of all our coal taken from different parts of the bulk, and smashed up together, and sent up to the analyst to be reported upon.

5636. Only one analysis was made?—Yes, that is all.

5637. And arsenic was found in very small quantity?—Yes.

5638. But you cannot say whether any of the samples of anthracite coal you used were entirely free from arsenic?—I should say it was not; it might have been.

5639. It is conceivable that if out of the twenty samples, or whatever it was, if one contained a great deal of arsenic, that fact would not appear in an analysis made of an average?—I picked out all the worst pieces I could find in selecting this coal; I wanted to find it out.

5640. But the analyst only made one analysis, it was an analysis of an average, and not of a separate portion?—No.

5641. (Sir William Church.) What do you mean by the worst?—What I thought was the worst.

5642. Those which had traces of iridescence on their surface?—Yes.

5643. (Chairman.) Is not pyrites visible in the anthracite?—Yes.

5644. You spoke of the threshing machine being severe on the barley by breaking up the grains?—Yes; inferior threshing smashes the corn, breaks it in half.

5645. Does not that destroy it for germination?—No, altogether. It skins it, and produces mould on the floors.

5646. The old threshing by flail was safer?—Far better.

5647. Is that practised now?—Very little. They would never get through it.

5648. (Dr. Whitelegge.) Can you say why it should cause mould?—I do not know that I could.

5649. (Mr. Cosmo Bonsor.) There is another form of mould, what we used to call red mould. What does that come from?—Really from injured grain, or rotten grain, badly harvested grain.

5650. Not from the manure used?—I cannot think so. I think it comes from badly harvesting stuff, it is not in proper condition when it is put into the stack.

5651. It has been suggested that the use of guano and different things would produce a red mould on the floor?—I know it has, but I do not follow it at all.

5652. The red mould is rare now since barley has been kiln dried?—It does not have quite the same effect, but still it is there in bad harvests.

5653. (Chairman.) Then, as to the mode of preparing dark malt?—Do you mean brown malt or black?

5654. Black or brown?—Brown malt is dried with wood, black is dried in cylinders.

5655. Brown malt is dried with wood instead of anthracite coal?—Yes.

5656. Is that much used?—It is used for stout and porter.

5657. Would wood not give malt suitable for pale ale?—No. It could not be used for pale malt.

5658. Is the wood much more expensive than the anthracite coal?—Yes, it costs more to make brown malt than it does pale.

5659. The black malt is produced by roasting in cylinders?—Yes; pale malt is made first, and then put into cylinders.

5660. And there is no distinction between the malts afterwards put into cylinders?—Can you put any malt into the cylinders?—You could do so, but the malt that is put into cylinders for black malt does not require the same amount of germination and flooring that making pale malt does. You curtail the flooring.

5661. In the cylinders it is not exposed to fumes from the fire at all?—No.

5662. (Dr. Whitelegge.) But it has been exposed to the fumes at an earlier stage?—It has. It is made into pale malt to begin with.

5663. Do you know of maltings where a pneumatic system is adopted?—Yes. I have one of my own. The system to start with up to the cistern, is the same. After leaving the cistern the grain is put into drums or squares and cold air, or moist air is drawn through the grain. It is then laid on the kilns exactly in the same way as in ordinary floor malting, and the same process proceeds as in the ordinary floor process.

5664. Laid on a floor through which the fumes pass?—Exactly the same way as the ordinary floor system of malting.

5665. What is the effect of the pneumatic system?—By it you can malt all the year round, whereas in the ordinary floor process you have to malt when the weather is suitable.

5666. I understand the floor process is used in connection with the pneumatic system?—It is.

5667. But still the pneumatic system allows you to go on with the malting in very hot weather or cold weather?—Yes.

5668. I do not quite understand how the pneumatic system has that effect?—It enables you to malt all the year round if you wish; whereas you cannot do that on the ordinary floor process.

5669. (Sir William Church.) The pneumatic system is a different process during the germination of the grain?—Yes.

5670. Not in the drying?—No, in the germination only.

5671. (Chairman.) Where does the germination take place?—In the drums or squares.

5672. It does not take place on the open floors?—No.

5673. All the kilning is exactly the same?—Yes. In some cases drums are used for kilning, but it is not thought much of.

5674. Does the drum revolve?—Yes, slowly.

5675. Does that interfere with the germination?—No, if you mean in the germination drum.

5676. Does the pressure and temperature differ from that of the atmosphere in the pneumatic system?—We can work at a given temperature, whatever you want to pretty well.

5677. (Dr. Whitelegge.) Would the use of this system in any way lessen the risk of arsenical poisoning?—Not at all.

5678. (Chairman.) There is no malting on the pneumatic system carried out so that the products of combustion do not reach the malt?—No, I do not think there are in our part of the world. In Germany it is.

5679. In Germany the pneumatic system is carried on and finished without exposure to the fumes?—I believe so, but I do not think that process would answer in England. We could not produce the malt that the brewer would like, there would be no finish to it. I have never seen any of the malt I have seen made in Germany which would suit the London or Burton brewer at all.

5680. Why not? Does not it make good beer?—A different class of beer altogether.

5681. You do not approve of German beer?—I like it very much, but it is a different class of stuff altogether.

5682. (Mr. Cosmo Bonsor.) The flavour of malt comes from the kiln drying?—Yes, altogether, and it is in the finish that the value of malt is ascertained.

5683. (Chairman.) In the German beer produced by this pneumatic system without exposure to the fumes of combustion, there is not at all the same flavour?—Not at all, it is a different thing altogether.

5684. Bavarian beer and Vienna beer are made of malt kilned in the same way that we do it in this country?—No.

5685. Are they supposed to be made of malt not exposed to the fumes of combustion at all?—I believe so in most cases.

5686. And lager beer?—I believe so, but I am no authority on that subject.

5687. (Sir William Church.) By exposing it to higher temperature, could not you get the same charring in the cylinders you do from the direct fumes?—Are you speaking of malt dried on the kiln?

5688. I am speaking of malt dried in cylinders like German malt?—I have never seen any successful operations in that way, and I have seen a good many.

5689. The peculiar flavour of English malt is not due to a charring of the malt itself, but is due to the actual addition of the flavour from the fume?—I think so, I should put it that way.

5690. (Chairman.) Is there any flavour from anthracite?—Not that I know of.

5691. We know the peat reek in Scotland where the flavour is distinctly different?—Yes.

5692. (Sir William Church.) If it is only obtained from charring of the malt that would be a matter of regulating the temperature in the cylinders?—Yes. Anyhow the malt dried in cylinders, and not exposed to the fire is at the present time thought to be of no use.

5693. That I follow; but I wanted to know whether you could give us any evidence that that was due to alteration in the composition of the malt itself, or due to the addition to the malt of something obtained from the fuel. For instance, with wood you must get a good deal of what are called empyreumatic oils added?—I have no knowledge of that.

5694. What wood is used chiefly for brown malt?—Hazelwood, ordinary faggots kept for some time.

5695. Are any woods excluded?—No.

5696. When you say hazelwood you mean merely ordinary underwood, faggotted?—Yes, it is a different class of malt altogether.

5697. (Chairman.) And the beer has a different class of flavour?—Absolutely. I do not know of any way of drying pale malt with wood.

5698. (Sir William Church.) I am wanting to see whether the flavour of brown malt is added by the fuel or by the methods in which the malt is made?—No, by the fuel solely.

5699. The flavour of it is produced by the fuel?—Certainly.

5700. Therefore the flavour of the pale malt to a certain extent is produced by the fumes of the anthracite coal or the coke?—I should say so certainly.

5701. Do you exclude fir for instance from the wood you burn?—Yes, we use nothing else but hazelwood.

5702. Hazelwood is distinct from ordinary underwood?—We have to have it as we get it pretty well.

5703. You do not use particular wood? Beechwood would contain a much larger amount of substances like creosote than really nut wood?—Yes; we buy it as well as we can.

5704. Hazel is the trade name for it, but it is an underwood?—Yes, it gets a mixture of other stuffs in with it.

5705. You would exclude fir?—Yes, we should; we could not get it to begin with.

5706. (Chairman.) Would you object to it if you had it?—I think very likely we should.

5707. (Mr. Cosmo Bonsor.) Have you ever tried it?—No, I have never tried it.

5708. (Chairman.) Is there anything else that occurs to you besides what you have told us?—I do not think so.

5709. (Sir William Church.) You said the trade was upset rather by this scare, but you would think that it was improper that such an amount of arsenic should be added by the fumes of coke as to produce considerably more than one-twentieth grain of arsenic in a gallon of beer?—I cannot think there is any arsenic in malt to cause any harm.

5710. It has been shown that the beer brewed with malt alone without glucose in it, one sample especially contained as much as one-seventh of a grain per gallon?—There may in some cases be a very bad piece of coal or coke which may produce that, but I do not think generally it can happen so. There is no devilry of any sort or description in the manufacture of malt, everybody tries as far as I know to produce the best article he can. There is no trick in the trade.

5711. But no one was aware until quite recently that the use of gas coke opened up this?—It has been always used and in some places nothing else. In the North and Midlands they never used anything else for years. In Burton where they make the finest malt, and are supposed to make the finest beer, they never used anything else for years.

5712. I believe they used oven coke a good deal at one time?—And gas coke, too.

5713. Gas coke was not so abundant once as it is now, and we have it in evidence that oven coke contains very much less arsenic than gas coke?—I believe that is so.

5714. You yourself say you would use oven coke?—I should in preference.

5715. Do you think there is no danger then where

gas coke is used without any restriction?—I think an inferior gas coke would be very likely detrimental. I think inferior coal would be also detrimental, there is no good in using it, and if you prohibit it it would be a very good thing.

5716. (Chairman.) It has been suggested that gas coke from one district in England was practically free from arsenic, but that in another district the ordinary gas coke contained a good amount of arsenic. Have you experienced anything like that?—No; we use nothing else but anthracite coal in our district.

5717. (Dr. Whitelegge.) In what way do you suggest that a standard ought to be fixed?—As anthracite coal cannot be guaranteed free from arsenic absolutely, I would suggest some standard of limit which the maltster may work to.

5718. A standard of anthracite coal or a standard of what?—Arsenic.

5719. Arsenic in the malt or in the coal?—In the malt. I do not think you can produce malt absolutely free from arsenic for the very good reason that coal is not absolutely free.

5720. Would you not agree that it is desirable to exclude even the least trace of arsenic that can be done?—I do not think it could be done.

5721. Would it be desirable?—Certainly; but I do not think it can be.

5722. If there is a variety of anthracite coal free from arsenic, would you agree that it is preferable to use that rather than an anthracite coal containing a little arsenic?—Certainly.

5723. Would there not be danger, if a standard were introduced, of suggestion that it was immaterial whether the arsenic below that minimum were excluded or not?—No; I do not think so.

5724. Do you think it is necessary for maltsters who use anthracite coal to examine for arsenic?—I do not think it is, if you ask me, although we do it now.

5725. If there were a standard, what would you propose the maltster should do? Test his malt from time to time?—We do that now.

5726. But not to give any special attention to the coal?—No, certainly not; he might have it analysed to start with.

5727. Have you any suggestion to make as to the amount of arsenic that should be specified on a standard if any were specified?—I could not say that, but I think you can produce malt if dried by good anthracite coal, practically free from arsenic. I do not think you can guarantee it—that is my point.

5728. What would be the object of the standard—to enable the maltster to give a certificate that the arsenic did not exceed a given standard?—Precisely.

5729. (Sir William Hart-Dyke.) You mean you can guarantee the standard, but you have a difficulty to guarantee an absolute freedom from arsenic?—We are advised that we cannot get it absolutely free.

5730. (Mr. Cosmo Bonsor.) If some public authority were to settle the standard, do you think every maltster could keep practically below it?—Yes; that is what I think should be done—that is my point.

5731. (Chairman.) Your own chemists could test it and keep it out at the right time?—I think so. We continue to have our malts analysed for arsenic from time to time, and we endeavour to keep within that standard.

5732. (Dr. Whitelegge.) And always with negative results. You told us that the malt samples had never been found to contain any arsenic whatever?—I was only quoting my own instance.

5733. The malt had been frequently examined and you never found arsenic?—Yes, we were at it every day. We are asked to guarantee malt and keep it free from arsenic.

5734. (Chairman.) What quantities of malt are taken in the chemist's test?—A very small proportion.

5735. Have you thought of having a still more searching test of a larger quantity?—No.

5736. Do you think that the freedom from any trace of arsenic in the samples you gave is practically sufficient?—I think so, certainly. I do not see how you can do it in any other way. In our own business we are endeavouring as far as possible to work within those lines.

Mr. H. A. Taylor.
26 Apr. 1901.

Maximum quantity of arsenic in malt should be officially fixed.

- Mr. H. A. Taylor. 5737. (Sir William Church.) Do you know what quantity your analyst uses in the sample?—No, I do not.
- 26 Apr. 1901. 5738. You do not know whether he examines half a pound or a pound?—I could not tell you. I should think less than half a pound.
5739. (Chairman.) The quantity tested is of very great importance?—The sample is drawn from a large

bulk of stuff, a thousand quarters of malt. We draw a sample from the bin, and an average sample is sent up to be analysed; we can do it in no other way.

5740. But the quantity the analyst actually uses would be of great importance?—I do not know what he uses, but I should think less than half a pound. It is a very small quantity.

Mr. H. Taylor. 26 Apr. Method of sampling malt.

Mr. CORNELIUS O'SULLIVAN, called; and Examined.

Mr. C. O'Sullivan. 5741. (Chairman.) You are a Fellow of the Royal Society?—Yes.

5742. And you undertake the scientific and chemical work for Messrs. Bass and Co.?—Yes, at Burton-on-Trent.

5743. You have some information to give us on certain points we are enquiring into?—Information has been asked of me on the following points:—

(1) As to precautions which in your Burton experience have, in view of recent events, been considered necessary or desirable, to guard against the introduction of arsenic into beer, by any ingredient (sugars, malts, etc.).

(2) How far, in your experience, it has been found practicable to eliminate risk of introduction of minute quantities of arsenic into beer; and

(2a) Any other matters within the reference of the Commission.

In reply thereto I may say:

(1) When it became known, through the daily papers, about the 23rd of last November, that arsenic was found in some beers, although the source whence it was derived was clearly indicated, it was deemed desirable, as a precautionary measure, by the Burton brewers, in common, no doubt, with the brewers all over the country that every source by which arsenic could be introduced into beer should be carefully examined; and, as the sugars of different kinds, employed as malt substitutes, were the sources chiefly implicated, at least to begin with, the use of these was discontinued in most cases, at once, although examinations have since shown the precaution unnecessary; the sugars, as a rule, have been found free from arsenic, or at least practically so. Further, it was considered desirable that all beers in stock should be examined by the local staffs and by outside authorities. Burton brewers have, as a rule, competent chemists on their staff, and those who have not employ such men outside. The general results were that the beers were declared practically free from arsenic. But when developments took place, and when the academic side of the question took the place of the practical one, it was found there was yet something to learn as to the presence of minute quantities of arsenic in beer and as to the sources thereof. It was observed that in some of the beers these minute quantities of arsenic were greater than in others. The cause of this was enquired into, and it was soon established that malts dried with a proportion of gas-coke contained much more arsenic than malts dried with a proportion of oven-coke. These facts were confirmed by outside observation. The use of these malts was at once discontinued, and as a further precautionary measure, even oven-coke was, as a rule, discarded and the cleanest anthracite alone employed. For many years Burton brewers have used little or no gas-coke, for the simple reason that it imparted a smoky disagreeable flavour to the malt, which was carried to the beer. Of course, as far as practical, they bought no such malt. But, inasmuch as outside maltsters recognised this fact care was taken by them to eliminate the flavour by selecting the gas-coke they employed so that in most cases it was impossible from the odour alone to distinguish gas-coke malt from any other. It appears, however, that the selection of the non-flavour giving varieties of gas-coke did not also eliminate the arsenic-containing ones. Hence, it was deemed desirable to discontinue the use of all outside malts, until they were tested and found to be practically free from arsenic.

Minute quantities of arsenic in Burton beers

attributed mainly to coke-dried malt.

Use of gas-coke discontinued.

All these precautions notwithstanding, it was still observed that all the beers were not absolutely free from arsenic, when the rigorous test was applied; quantities varying between 1-100th to 1-500th grain per gallon and practical purity were certified to by

competent authorities. I may mention, as an example, that I have had examined by a leading authority, with whom our own observations are in broad agreement, 32 samples of different beers, the products of some of the chief breweries of England, Ireland and Scotland, and of Holland, with the results that they contain quantities of arsenic trioxide, varying between 1-50th of a grain per gallon and practically nil.

The nil samples amount to 3 in the 32, and I believe two of these are part sugar beers, or beers brewed with part grits, made from flaked maize or rice.

This being the case, the cause of it and the means of obviating it had to be sought for. An examination of malt dust, i.e. the dust obtained on screening and fanning the malt after the grosser rootlets had been eliminated, showed that it contained much more arsenic than the malt itself; hence it has been decided to put up apparatus containing brushes and screens of the highest efficiency. They, I believe, will still further reduce the infinitesimal quantities of arsenic in beers, but I cannot hope that they will be, thereby, absolutely eliminated.

Mr. O'Sullivan

Arsenic reduces brush

Hops have also been carefully examined, and although many growths have to be rejected in consequence of the large quantity of free sulphur they contain, very few samples have been found to contain arsenic, in fact, they may so far be said to be absolutely free. As, however, sulphur washes are used during their growth, as they are frequently treated with free sulphur when maturing, and as sulphur is used in the kiln fires during drying, it would not be surprising if hops, too, will on further investigation be found to supply their quota, however small, of arsenic to beers. This is also a contingency against which brewers will, of course, have to guard.

Hops are free from arsenic

(2) I have indicated above the precautions taken which were considered desirable with the view of eliminating the risk of introducing even minute quantities of arsenic into beers and partially the results that might be expected. All the precautions taken have, I believe, led to a large diminution, but I cannot say that they have, so far, effected complete elimination in all cases.

I believe it can be shown that beer must have contained minute quantities of arsenic from time immemorial, but I believe there is no evidence that any effects, injurious to health, attributable to this quantity of arsenic, has so far been recorded. Methods for the detection of arsenic in beer are given in analysis books, but it is fairly clear that this arsenic is supposed to be introduced by accident or malicious intent.

Beer must have contained minute quantities of arsenic from time immemorial

I do not wish to deal with the methods of determination of minute quantities of arsenic. I may say, however, that I believe they are in some hands broadly satisfactory, as far as they go, but I am strongly of opinion this matter should be treated as the water commission treated the pure water question, that is, institute an enquiry into it with Governmental authority, so that practical methods may be established and uniform results insured.

(2a) Should there be any other points within the reference upon which the Commission may wish to examine me, I shall, in duty bound, be glad to give all the information within my knowledge.

5744. (Sir William Hart-Dyke.) I suppose you naturally, in common with all those connected with this trade, took great alarm when the news became known of this epidemic at Manchester?—I do not think I would admit the word "alarm." We certainly became nervous at the matter, but inasmuch as from time immemorial we have never observed any evil effects from the use of moderate quantities of beer we did not feel that as far as we were concerned, especially considering the materials we employed, there was very

much to fear, or at least that there was anything to be alarmed at.

5745. Were you in the habit of using glucose in any shape?—Yes.

5746. Could you tell the Commission in what proportions you used it?—Taking it all and all probably about $2\frac{1}{2}$ per cent. upon the malt.

5747. The rest being malt?—Yes.

5748. And what steps did you take for the future security against poisoning?—We immediately examined the glucose as a preliminary step, and then, lest in the past, not having examined the glucose, any of the stock might have been brewed with arsenical material, the beers that had already been produced were carefully examined until they were declared free. That is as far as my firm is concerned, but I think I am speaking broadly for the district of Burton-on-Trent. I think it would be scarcely fair to speak only of my firm. I would have it understood I am speaking for the brewers of the district as far as it is within my knowledge.

5749. Burton brewers have competent chemists on their staff?—Yes, and the smaller brewers employ outside men.

5750. They would call them in for emergency or on occasion to do the work?—As a fact, probably two or three of the smaller brewers have certain consulting brewers and chemists in common. They fee them by the year and on the amount of analysis they do afterwards. So that they are really and practically quite safe.

5751. (Professor Thorpe.) You mean they have a retaining fee?—Yes.

5752. (Sir William Hart-Dyke.) The general results in the initial stages of your enquiries for arsenic were good?—As far as the methods of analysis at first employed were concerned, the declaration by ourselves as well as by one of the best analytical chemists in England were on the side of practical, if not absolute purity.

5753. Later you found, did you not, some change took place with further developments?—That is so.

5754. Could you tell the Commission a little more as to what steps you took then?—It was then of course necessary to discover the sources from which these minute quantities of arsenic were introduced into the beer. To begin with I may say it was very difficult to satisfy ourselves they did exist there. However, as time went on there was no difficulty in establishing the fact, and then it was necessary to determine from what source these traces were derived. The different varieties of malt employed were examined, and as a broad fact it may be stated that the malts which were imported from outside sources showed a larger quantity of arsenic than those produced in the town itself. Therefore from the effect to the cause was a very short step. Enquiry showed that most of the bought malts were dried with gas coke, or partially with gas coke, and as a rule that the malts made in the town were dried with anthracite and oven coke, anthracite being used in larger quantities probably than elsewhere. Hence it was a fair conclusion that the source of the arsenic in the malt was the coke. The brewers therefore making their own malts rejected the coke altogether, and used nothing but anthracite.

5755. (Chairman.) Formerly they had used gas coke and oven coke?—In some of the firms of Burton-on-Trent I believe gas coke was used to some extent, but I cannot say it was used to any large extent, because the flavour of gas coke beer, unless the gas coke is very carefully selected, is objectionable.

5756. (Sir William Hart-Dyke.) Smoky is it not?—Quite so.

5757. I suppose, generally speaking, as regards the breweries with which you are connected, your opinion is that if mischief were to arise it would come from the use of gas coke?—It would be very difficult to say that altogether because we have no definite experience, and we have no definite evidence as to what variation may take place in the composition of anthracite or in the composition of oven-made coke. It would be almost impracticable to answer your proposition at the present time.

5758. You think there would be greater security in the use of anthracite than in oven coke?—I do not think there is any large amount of evidence for that at the present time; I believe oven coke can be got

quite as clean as anthracite. I have found large quantities of malt made from mixtures of oven coke and anthracite quite as pure as those made from anthracite alone.

5759. Given the three species of fuel, anthracite, oven coke, and gas coke, if you are asked to eliminate from those three the most dangerous, you would eliminate gas coke?—Yes, certainly. And I think the evidence at the present time so far is against oven coke too, and is strongly favourable to anthracite, but the time at the disposal of those persons who are investigating the question has been so short that the quantity of evidence is not sufficiently great to come to any absolute decision on the point.

5760. You say for many years the Burton brewers have used little or no gas coke on account of this smoky disagreeable flavour?—That is so.

5761. You said outside maltsters recognise this fact, and action was taken by them to eliminate the flavour by selecting the gas coke they employed so that in most cases it was impossible from the odour alone to distinguish gas coke dried malt from any other?—I believe that is really so.

5762. But that the selection of a known flavour-giving varieties of gas coke did not altogether eliminate the arsenic containing varieties, and therefore it was desirable to discontinue the use of all outside malts altogether?—That is so in my experience. Practically the outside malts, malts that have not been made by ourselves, are not used at the present time except in probably two cases in which the malt is found to be absolutely free, and these malts are also known to be anthracite dried malts.

5763. You have had a large number of samples of different beers tested, have you not?—Yes.

5764. You said "by a leading authority." Could you tell us more about the application of the test and give the authority?—Do you think it is necessary, sir?

5765. (Mr. Cosmo Bonsor.) Was it the Marsh test of the Reinsch test?—The Marsh test, the Berzelius Marsh. He used sulphuric acid in greater part with a little nitric acid so as to eliminate as much as possible the organic matter. I will tell you, if you wish, that it was the firm of Calvert and Thomson of Manchester.

5766. I think they have made testing for arsenic in rather a special part of their business?—As far as I know Mr. William Thomson has had a great deal to do with the testing—at least I have it from hearsay that he has had a great deal to do with the testing for minute quantities of arsenic in cloth, carpets, and such things, because it is said there are some countries, for example, Norway and Sweden, where they will not allow a carpet introduced into the country containing more than $1/600$ th of a grain of arsenious acid to the square foot. I do not give it upon my authority; I have only heard it said.

5767. (Chairman.) Mr. William Thomson has been testing for carpet manufacturers?—That is my information; I have been so informed.

5768. How was the arsenic supposed to get into the carpets?—By the dyes, I daresay.

5769. (Sir William Hart-Dyke.) You say out of all these 32 samples, those containing none whatever were only three?—That is the report.

5770. And that two out of those three were beers in the composition of which sugar has taken a part?—That is the inference in consequence of the breweries from which they are derived.

5771. They came from breweries in which sugar is used?—Yes, where it is used as a malt substitute.

5772. From breweries in which in no case malt and hops alone are used?—That I cannot say definitely, only they are known as breweries in which sugar is used as a malt substitute.

5773-4. (Sir William Hart-Dyke.) The largest quantity found per gallon was $1/50$ th of a grain?—Yes, that is so.

5775. Have you taken some trouble to examine malt and malt dust or combings?—We have examined the malt dust and the malt itself; by the dust, I mean the matter still adhering to the grain after the rootlets or combings are screened out. It is capable of being detached by abrasion, and, as a fact, when even well-screened malt is moved about in sacks, a considerable quantity of it becomes loose and can be separated by

Mr. C. Sullivan.
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Oven coke and anthracite compared.

Gas coke suited for flavouring not necessarily satisfactory qua arsenic.

Arsonic in carpets.

enic in attributed mainly as coke.

coke give objectionable pur to

Arsonic in malt dust.

Mr. C.
O'Sullivan.
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screening and fanning. It was in the dust thus obtained I found much more arsenic than in the malt itself.

5776. When you say "dust" you are referring to the dust and rootlets, the result of the screening process?—I am referring to the dust obtained by abrasion after the rootlets have been separated.

5777. You said "examination of malt dust," that is the dust obtained on screening and fanning the malt after the grosser rootlets had been eliminated?—Yes, the grosser rootlets formed by the germination of the seed are broken off by machinery and separated by brushes and fans and by screens, and then the malt still contains matter which is capable of being removed from its coating by abrasion. That matter is the dust which I say was examined and found to contain more arsenic than the malt dust itself.

5778. (Chairman.) Was the portion of the dust containing the rootlets also examined for arsenic?—I have not examined them nor have I had them examined, but I should say that they would be as likely to contain arsenic upon their surface as the malt itself.

5779. (Sir William Hart-Dyke.) You say you decided to increase the efficiency of this process?—Yes, we are putting up, and I believe most of the maltsters in England are putting up, brushing, fanning, and screening machines, so as to attack this small quantity and eliminate as much as possible the removable dust, at a very considerable expense, too.

Arsenical
malt which
cannot be
sold at
present time.

5780. That is your experience of the trade at present?—It is within my knowledge in certain cases, and I have it from hearsay in many others. There is no doubt that many of the maltsters in England have malt on their hands at the present time that they cannot sell, and everything is being done to eliminate the quantity or the proportion of arsenic that may be considered detrimental to the malt. That is absolutely within my experience.

5781. The presence of arsenic in malt at all or in this dust after screening has come as rather a surprise to the brewing trade and malting trade?—Absolutely as a surprise.

5782. There was no suspicion of it before?—Not a suspicion to my knowledge.

5783. (Chairman.) I gather that some maltsters have on hand malt they are not able to get quit of, is that because of arsenic?—So I am informed.

5784. Before the scare it would have passed as a matter of course as good malt?—Certainly.

5785. Do you know at all how much arsenic there was in any of that malt?—I should not like to say, but in some cases probably as much as 1/100th of a grain to the lb.

Proportion
of malt in
all-malt
beer.

5786. (Mr. Cosmo Benson.) What would that show in beer?—Taking 3 lbs. of malt to the gallon of beer, which is a little above the average gravity, it would bring it down to 1/33rd grain per gallon.

5787. (Professor Thorpe.) That assumes it all went in?—Quite so. I should not like to assume it for the moment though.

Malt can be
rendered
practically
free from
arsenic.

5788. (Sir William Hart-Dyke.) Have you any other suggestions to make beyond the care with regard to screening?—I do not really see that any other is necessary. I have made experiments by carefully brushing malts that I knew were moderately contaminated, contaminated probably as high as 1/100th grain to the lb., and when these malts were properly brushed, brushed as efficiently as the machines being put up can brush it, they were practically free from arsenic. I do not mean to say that if a man took 5 lbs. of it and got it down by hydrochloric acid and chlorate of potassium he might not get a mirror in the Marsh's apparatus, but for all practical purposes I am perfectly sure that malt would be free from arsenic.

by careful
cleansing.

5789. To your mind the real solution of the difficulty and the way to get security for the consumer of beer in the future, is to have this malt practically and thoroughly dealt with by a cleansing process?—That I believe is the practical way out of the difficulty at the present time.

and se'ction
of fuel.

5790. The fuel question is of course one of the most important elements?—As a matter of fact, there is no evidence so far that any arsenic carried into beer through the malt is derived from any other source than from the fuel. That may be taken as a fairly approved fact, I think.

5791. Would you suggest that if it were proved either through this enquiry or otherwise that gas coke is far more liable to cause the presence of arsenic in malt, it would be necessary to go so far as to forbid the use of gas coke for malting?—The difficulty in my mind would be how to prevent it, because if coke at all were used you could not put the key upon the gas houses or upon the malt houses, and it would be very difficult to prevent it going in. You would have to get a good many people to watch it to handle the matter in a practical way.

5792. But do you think that, considering all that has happened, the malting trade as a rule would use their utmost endeavour to protect the consumer of beer and are now inclined to use anthracite or oven coke as much as possible?—I am perfectly satisfied that there is no maltster in Britain who is not doing everything he knows to eliminate the traces of arsenic that his malt may contain, and that therefore if it is thoroughly impressed upon him that there is any risk of the introduction of arsenic by the use of any fuel, he will spare no trouble to eliminate that fuel. It is a very serious loss to the maltsters of this country at the present time to have the amount of malt they have on their hands, and cannot sell or handle in any way unless some means is devised to eliminate a considerable quantity of the arsenic. Therefore to prevent any possibility of that loss of money in the future they would take every precaution that could be possibly taken or they could be helped to take by the scientific experts from outside.

5793. (Chairman.) The malt they have in their hands could not be purified by any rigorous process of brushing?—I think I have said I feel quite satisfied that with the systems of brushing that are being devised the larger quantity of the arsenic will be eliminated.

5794. And has that been tried, do you know, on the stock in hand they have so much trouble about?—I believe it has to some extent, but it takes a considerable time to have these brushes made and there are only a certain number of men in the country who have the apparatus for making them. Therefore it takes a considerable time before they will be in proper use. I feel inclined to think myself that, except for the stock of malt that is on hand, by the time they are erected they will be absolutely unnecessary, that the malt dried by anthracite will be sufficiently free for all practical purposes.

5795. In the public interest would you think it would be advisable to have a rule about the fuel used, that it must be arsenic free, or would you let the rule for the security of the public be, that there is not to be arsenic in the malt, or the double security that the fuel is to be arsenic free and the malt arsenic free?—As far as any security of the fuel being arsenic free is concerned, I believe it is a proposition outside the range of practical politics, so to say. It is out of the range of practicality. You get a seam of coal 100 yards in length and take blocks out of different lengths of that seam, and examine it for any one of the constituents. I have had to do it for the amount of chlorine that the seam of coal may contain, and I found that the variation was considerable. If, in the case of one constituent, I ask why not in the case of the other? I do not say it has been done for arsenic, but I have not the least hesitation in saying that what holds good for one small proportion of a thing will hold good for the other, and the seam of coal examined its whole length will not show identically the same quantity of arsenic. And I believe if it did we have no methods at the present time sufficiently accurate to determine that point to satisfy all conditions, because I maintain that colour tests, tests by comparison although right enough in their way, until one can weigh and measure—and these are only correct within certain limits—one cannot be satisfied that there is any real security with regard to accuracy.

5796. (Sir William Hart-Dyke.) With all the precautions human ingenuity can devise you think there is always a possibility of there being some arsenic in the beer that is drunk?—I should not like to say that. I think I have been able to prepare a beer that was absolutely free from arsenic, and I have plenty of beers certified to be absolutely free by even the most rigorous test.

5797. (Professor Thorpe.) Do you consider that preparation of such beer involves the same order of difficulty as making a chemically pure chemical?—Quite in that same order.

Mr. C.
O'Sullivan.
26 Apr. 1901.
Difficult to
prohibit use
of gas coke
by maltster.

Arsenical
malt—loss
to maltsters.

Removal of
arsenic by
brushing.

Distribution
of arsenic in
coal probably
very unequal

Beer can be
rendered
absolutely
free from
arsenic.

Mr. C. Sullivan. 5798. (Chairman.) Your remarks about fuel apply to anthracite. You think there may be arsenic in some specimens of anthracite, and not in others from the same bed?—That I must admit.

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5799. The employment of sugar or glucose as malt substitutes was discontinued?—Yes, as far as most of the breweries in my district are concerned, it was discontinued as malt substitute. In the question of malt substitutes in contradistinction to any other use that sugar is applied to, I may say the malt substitute is intended to displace a certain quantity of the malt. It is used in the copper and boiled with the wort. That is the sugar used as a malt substitute. There is a small quantity of sugar solution-glucose or cane sugar being employed as priming, and added to beer after fermentation. This I do not include under the head of malt substitutes.

amount of using in er.

5800. What you refer to now is sugars used for priming?—Yes, glucose, and some brewers use well crystallised sugar candy.

5801. That would just sweeten the beer?—The quantity used would be so infinitesimal that it does not enter into the question. If you take it that probably there would not be much more than $\frac{1}{2}$ per cent. upon the extract, in some small breweries it may go up to a great deal more than that, but in those breweries where it is really looked upon and introduced as a priming it does not exceed $\frac{1}{2}$ per cent.

5802. If there is any arsenic in the priming that all remains in the beer?—Yes, certainly, except it should be eliminated by the after fermentation, by the yeast taking up any portion of it.

5803. But the priming is applied to beer, the whole of which is put into barrels?—Quite so.

5804. So that it would be only by depositing in the barrel that any of the arsenic could fail to be in the beer?—That is so.

5805. You found afterwards that the giving up of the use of the sugars was not necessary?—That is my experience at the present time, the sugars on the market are practically if not absolutely free from arsenic.

5806. Would you still approve of those sugars being used in the two ways, both as malt substitutes and as priming?—I do not say I would approve, but I would have no objection.

5807. In high class beers is sugar used as priming?—Yes, certainly.

5808. And in the lighter class of beers, which I suppose were chiefly concerned in the epidemic, would there be glucose in the priming there, or in the brewing, or both?—In both.

5809. And a large quantity of it?—In the brewing, as the malt substitute.

5810. But a small quantity in the priming?—About the same as usual, I should say.

fect of ming.

5811. In the beers you speak of when the use of the sugars was given up, was the quality of the beer sensibly altered?—I should say not really, in my own experience. I have heard some men say since they had to give up a certain small quantity they did not get the fineness of flavour, and had to use the better class of malt.

5812. And then they get the good quality in the beer?—Yes. That is putting the facts broadly.

5813. So that the use of glucose not only renders a smaller quantity of malt necessary, but allows of an inferior quality of malt being used?—I do not quite understand the question.

5814. I think you said that when they gave up the glucose, they were obliged to use a higher quality of malt?—That is so, and to displace the quantity of sugar by a quantity of malt equivalent to it.

5815. When you say a "higher quality of malt" in what respect was it of a higher quality?—That would be rather difficult to describe I must confess. Some brewers think that the malt they have to give the highest price for is the best malt. Others are satisfied if it gives a beer sufficiently good for their purposes. The question of real goodness is one of those things which it is very difficult to decide.

5816. Has the customer much to say in the matter, or the publican who sells to the customer?—I think, as a broad fact, he has pretty well everything to say on the matter. His tastes have to be very materially considered, and if they are not, he soon lets the brewers know. If one brewer, for example, in the town is sending out beer that is unsuitable to the tastes of the beer-drinking

part of the community, and the other brewer is sending out beer that is suitable, the brewer who is sending out the latter, will have the advantage in a very short time.

5817. We were told that some brewers before the scare gave up the use of glucose so as to have an all-malt beer, but that their customers did not like it so well, and they were obliged to go back and use the glucose?—That may be said, and probably it is true, but I hardly believe the point, taking it altogether. It was because the beer did not suit the customers that they had to go back to the use of glucose. I admit this fact; there is a certain luscious flavour in invert sugar, and also certain flavours in some of the glucose which are imparted to the lighter beers. When people get accustomed to these flavours they will not have anything else, so that I do not say it is quite an impossibility that a brewer going from sugar to malt may not be forced back to sugar again by the taste of his customers.

5818. That may be a perfectly healthful taste. The use of glucose does not make the beer less healthy, while making it more agreeable?—Certainly not. So long as it is a purely manufactured article, I cannot see that it is at all.

5819. Have you any analysis showing the quantity of arsenic in sugars referred to when you said that sugars as a rule have been found free from arsenic, or at least practically so?—At the time when these sugars were examined attempts to express such quantities as a 1-100th of a grain to the lb., or a 1-200th of a grain to the lb., or indeed, even 1-500th of a grain to a lb., seemed to be an absolute loss of time. It seemed to me at that time impossible to give a number when the quantity went below 1-20th of a grain to the lb. One may then form some idea that it did contain at least 1-20th, but one could not be sure of that. When, however, it went down to 1-200th or 1-300th of a grain to a lb., it was absolute guesswork, and I should say when it required, say 200 grammes or 300 grammes to establish definitely, there was some arsenic there, it may be altogether neglected, although it may have been put down as 1-300th to a lb.

Character of beer may depend on local taste of public.

Estimation of minute quantities of arsenic, largely useless.

5820. But you would say now 1-300th of a grain to a lb. might be measured?—A fair guess might be made at it. For example, I believe if it were put in the hands probably of three different men, and even men working upon the same lines, that one might very easily return it as 1-200th of a grain to a lb., and the other 1-300th of a grain to a lb., and the other 1-400th of a grain to a lb. I believe that is the condition of things in which the determination stand at the present time.

5821. Even by the most careful and well-skilled analysts?—I believe that is so.

5822. You have used the Marsh test, I think you said?—For the smaller quantities.

5823. Do you find it is more trustworthy for the smaller quantities than the Reinsch test?—I may say that I agree broadly with Professor Stevenson upon that point that in the hands of a man who knew how to work the Reinsch test, if the man had the concentration sufficiently right, and his copper sufficiently bright, and the mode of sublimation, which is the real crux of the question, under the proper conditions, I believe he need not miss 1-200th of a grain to a gallon in beer. I am perfectly satisfied he could show crystals of arsenious acid from a beer containing 1-200th of a grain to the gallon. But when it goes beyond that, and one has to concentrate, and the amount of organic matter in the solution is great, the deposit on the copper is not so regular, and one cannot rely on it so well as in the case of dilute solutions. Hence when it goes beyond 1-200th of a grain per gallon, it is rather difficult to get copper that will yield crystals with any degree of satisfaction.

5824. We have been told that sometimes the copper keeps some of the arsenic, and the sublimation is not complete; is that consistent with your experience?—I have never tested the question really. When one considers the analysis of electrolytic copper, and sees quantities down to 1-100th per cent., one would not be surprised that if arsenic gets near copper at all under any conditions the whole of the arsenic would be given up again.

5825. Have you ever tried deposit on platinum foil by electrolytic action?—I have not.

5826. (Professor Thorpe.) The arsenic which is present in the coal, and of course incidentally in the coke, is probably associated with the sulphur and the iron?—I think most likely.

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Form in
which
arsenic
present in
coal.

5827. That is to say, it would be present in what are called the coal brasses?—Yes, most likely, in the pyrites and the marcasite. Of course the pyrites vary very considerably in composition in the different coals. One kind would contain one variety of pyrites, and another another variety.

5828. But the pyrites itself if it were detected would be a significant thing to look for, and to avoid, so to say, in the selection of the coal?—I should say as a practical test for the suitability of the fuel required that the presence of any shining crystals or scales of pyrites would be very practical and important indication that the seam of coal, or the portion of coal that contained these traces, should be certainly rejected. I cannot say but it would be to the interest of the maltster to look for them.

5829. In the selection of any coal one might, so to say, keep off arsenic by keeping off coal brasses?—The evidence probably is not altogether quite satisfactory upon that point yet, but I believe in the main it may be taken as true. If you take a piece of coal and cut a cubic inch out of it, which appears to be all carbonaceous matter, I am not quite prepared to say that that block of coal might not contain some arsenic, but I am prepared to say that all other things being the same, coal showing the faces of either scales or crystals of pyrites are coals that will certainly yield the greater quantity of arsenic. I believe that is the point.

5830. That is what I want to get from you. But that method of selecting coal for industrial purposes is already in use?—I have heard so.

5831. The iron smelter, for example, in taking coal for his particular use will select it with the view to the avoidance of pyrites?—That is so.

5832. That presents no industrial difficulty?—No.

5833. Oven coke for the same reason I presume is less free from pyrites, because it is selected in view of a special purpose?—Quite so. There is no other possible reason that it should contain less.

5834. It has been selected for the absence of sulphur?—Yes. One of the curious things when one comes to consider the matter, is why it should contain any at all. Imagine the high temperature of the coke.

5835. It has probably been converted into other forms in a reducing atmosphere?—That is quite so.

5836. What is the difference in price between gas coke, oven coke, and anthracite?—I cannot say.

5837. Is it a factor which is at all likely to enter into the calculations of a maltster?—Certainly it must enter into the calculations of the maltster, otherwise he would not go to the trouble of using gas coke.

Price of
malting fuel.

5838. It is not the convenience of its being on the spot?—That may have something to do with it. I am speaking without the book, but with a certain amount of knowledge on the matter. You may buy gas coke in the town in large quantities at 13s. a ton, but I think at the present time probably you would have to give for oven coke 22s. or 23s.

5839. And for anthracite in your district?—Probably 23s. or 24s. I am speaking without the book, but it is sufficient for practical purposes. You may take it broadly that gas coke is materially cheaper than oven coke, and oven coke is somewhat cheaper than anthracite.

5840. As you put it, anthracite is double the cost of gas coke?—Yes.

5841. How far does the cost really enter into the production of malt?—I am afraid upon these matters, upon the commercial aspect of the question, I have very little knowledge. I neither buy nor sell anything connected with the trade except some very small things.

5842. The object of my question was how far any restriction as to the use of fuel was going to enhance the price of malt?—I think you may put it down that it will certainly enhance the price of malt. The alterations which have taken place already have put up the price of malt considerably; that is, of the available malt.

5843. (Mr. Cosmo Benson.) The cost of making malt, not the cost of the malt?—Yes, and of course the price, too.

5844. (Professor Thorpe.) In view of the greater stringency of purity required?—That is so.

5845. You told the Commission you think that by the time this brushing machinery is in general use the

necessity of it will be very largely obviated?—That I believe is true.

5846. Do you rather deprecate the brushing of the malt apart from this question of arsenic?—Not at all. As a brewer I think it is most desirable.

5847. (Sir William Church.) With regard to that question, would you be in favour of this brushing being done by the brewers or by the maltsters; the last witness said he objected to the maltster brushing because he could palm off inferior malt?—I do not think the brewer would object to have the maltster do it, but I think, taking it altogether, he would prefer to have the brushing under his own control. There is one more factor in the matter. If malt travels any distance after it is brushed or screened there is yet still more dust eliminated by the abrasion of the particles.

5848. That would be a further safeguard to the public?—In consequence most of the better brewers have fans and screens immediately before the mills to handle such malts. In other words, I believe it is impossible to move the best screened malt without having a certain quantity of dust develop in the process of moving. The rubbing of the corn against each other; the passage of the corn from the stack into the hopper, and so on.

5849. You, speaking as a brewer, would agree with the last witness, a maltster, that the final polishing and brushing had better be done by the brewer than the maltster before it leaves his malting house?—Certainly, I think there is every reason for it.

5850. Can you tell me what the flavour of malt depends upon?—That is rather a big question.

5851. You heard, I think, the last witness's evidence?—To some extent. The flavour of malt depends upon many things. I have not prepared evidence on this point, but I have my opinions on the matter, and am quite willing to give them.

5852. At present, to meet the requirements of the brewer, the maltster has to allow the fumes of the fuel to pass through his malt?—I think you may take that as broadly so.

5853. Do you think that it would be possible to obtain that flavour in the malt without the presence of the fumes?—What you mean to ask me is, whether it would be possible to so far cure the malt without allowing the fumes or the vapours of the fuel to pass through it, that it would be as acceptable to the brewer for brewing purposes as it is at the present time. I cannot say that, taking it altogether, I have any reason to believe that it would not be possible to produce as good a malt, giving flavour by the passage of properly heated air without the products of combustion, as it would be by carrying the products of combustion through.

5854. So that its flavour really does not depend upon changes due to the fuel? You say you do not use gas coke because you wish to keep out a disagreeable flavour, but you obtain the flavour that you need in the other cases by the use of coal fumes?—That is why gas coke was rejected.

5855. But you are not prepared to say the other is necessary for giving the required flavour?—I should say not, certainly. I know of no flavour that, provided the air was of sufficient temperature and the amount of water in the malt when the temperature was employed was suitable, the roasting flavour could not be given to the malt with heated dry air as well as with heated dry air plus the products of combustion.

5856. (Mr. Cosmo Benson.) You would still want a draught?—Naturally.

5857. (Sir William Church.) And the brown malt that is spoken of, which is dried by means of wood, is malt, merely that you want a shorter and fiercer heat?—I have no experience with it, except that I see it now and then. It is offered to me, but I do not handle it. It is to give a certain sort of body flavour, and generally used in porter and stout.

5858. Still, if I might have your opinion, it might probably be because you get a shorter and fiercer heat from the wood than you do from the anthracite coal?—It seems likely, but I could not bind myself to an opinion.

5859. It appeared to me like that?—It appears so to me, too. There is no doubt that brown malt is what is known as blown, that is to say, a high temperature is applied to it while it still contains a large proportion of water, so that the water in the grain is volatilised by that temperature, and the skin of the grain blown

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Brushing
malt
desirable
apart from
arsenic.

Should
be done by
brewer.

Malt
will
be given
satisfactory
flavour
without
exposure
to fumes.

Brown

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so as to be much expanded. If you get a sample of that malt, you will see that every grain of the malt is quite distended.

5860. Have you had analysed any of the combings?—No.

5861. You would not like, perhaps, to express an opinion whether they are likely to contain sufficient arsenic to be prejudicial to its use as a feeding stuff for cattle?—Under the ordinary conditions of drying, or even with use of ordinary gas coke, certainly not.

5862. You do not think that the use of the combings scattered over chaff and other things would be prejudicial to stock?—I should say not.

5863. What quantity of malt would you propose should be used as samples for testing, an ounce or a pound or what?—A good deal would depend upon the bulk to be sampled.

5864. I mean what amount should the chemist work with?—Some of them can work with as low as 10 grammes.

5865. You can imagine that malt might contain arsenic, that is to say, not be absolutely pure, and yet it would be impossible to detect the presence of that arsenic in an ounce, while it would be detected in a pound?—If it is found by examining an ounce there is the least trace, a more distinct indication can be obtained by using 1lb. or 10lbs., provided the reagents are sufficiently pure.

5866. I was asking you, rather supposing you agreed with the last witness in thinking there should be a standard laid down that there should not be more than a certain quantity of arsenic in malt?—That I should say distinctly would be a desirable thing, but it should be laid down with Governmental authority. I have in my own mind now the condition of things when the Water Commission first sat, or when the Water Commission was working. I remember as well as possible that the idea of estimating the 1-10th of a grain of ammonia to a gallon was simply scouted; a 1-10,000th of a grain per gallon now all analysts can detect. So that if we were to lay down to-day a certain standard, unless the method by which that standard was arrived at was clearly and distinctly stated, what we call the 1-100th of a grain to a gallon to-day may turn out later on to be 1-10th of a grain to a gallon. I do not know whether the authorities will agree with me, but it is my experience on the matter.

5867. Therefore you would not propose there should be any definite standard?—Not without accurate and careful investigation by competent men. I believe that these minute quantities of arsenic in all articles of food as well as in beer, malt, and so on, is a problem at the present time well worth investigation. It should be submitted to that investigation, and the results of it should be stated authoritatively. Then it would be for the doctors to say whether or not any quantity that could be determined by this method should be allowed.

5868. Given a definite amount and a definite method of working, what would be a convenient quantity of the malt to work with?—Anything between 10 and 100 grammes.

5869. (Professor Thorpe.) The amount, of course, to be taken must have some reference to the method which is used?—Quite so. That is the point I wish to accentuate. I want to point out that the method must be distinctly and definitely laid down. For example, if you take a thimble of glass and a cover glass, and introduce into the thimble copper from the Reinsch test, you will find it wants a large quantity of copper to get crystals, whereas the same amount of copper and the same amount of arsenic will give you, with the greatest ease, crystals quite distinct in a small tube. All you have to do is to diminish the size of the tube. In the one condition of things it is not obvious at all; in the other with the same quantity it is perfectly apparent.

5870. (Dr. Whitelegge.) What you said just now about standards referred more particularly to beer, did not it?—That was what I had in my mind at the time.

5871. Would you say a standard was necessary in the case of malt? The last witness proposed there should be a standard laid down by which the maltster should be guided, and which would enable him to give a certificate of freedom from arsenic?—I think that would be desirable. But if it were done in one case, I hardly think it would be necessary in the other.

5872. But you do not suggest at present what the standard should be?—No.

standard should be in either case?—Certainly not. Without further investigation I do not think we are in a position to deal with the matter finally; to put it in a condition that would be acceptable to the whole country.

5873. Do you make malt and buy malt?—Yes.

5874. In the case of the malt you make, how long has it been the practice to use anthracite?—Anthracite alone has been used only since the middle of December last.

5875. Did you analyse the coal used?—Certainly not.

5876. You cannot give us any figures?—No.

5877. You select the coal, I understand?—We do Anthracite select, putting it broadly; we get it from the South selected for Wales Colliery, where it is known from time immemorial to give the cleanest flavour. I do not think it value. has any reference to any other form of selection.

5878. Have you any apparatus for pneumatic malting?—No; we are putting up one, but we have not one working.

5879. When that is in use, will the anthracite coal still be exclusively used?—In regard to coal, as far as I understand, it depends whether they are going to dry in the drums or in kilns.

5880. You cannot tell us what the precise form of the apparatus will be?—I cannot tell you at the present time.

5881. In the case of the malt that is bought, do you ask for certificates?—Since the beginning of December certainly, and we examine samples before we attempt to buy.

5882. But in addition to the analysis you make, you ask for a certificate?—Certainly.

5883. (Sir William Hart-Dyke.) Certificate of purity?—Freedom from arsenic.

5884. (Dr. Whitelegge.) Entire freedom from arsenic?—They give it to you broadly; you will not get any one of them to give a certificate that it is absolutely free. But they give a certificate "practically free."

5885. Are those words used, "practically free," in the certificate?—I have not seen a certificate, but I understand that is the form of certificate that is used.

5886. (Sir William Hart-Dyke.) Will you put in the form of a certificate?—I will obtain one, and let you have it. I think it would be very much better to get this from a maltster, who may have it in a printed form in his hands.

5887. (Professor Thorpe.) I venture to think you are rather at cross-purposes in this sense. The maltster gives a certificate in good faith that a thing is free from arsenic?—Yes.

5888. What he really does is to give it to an analyst, who takes a determinate amount and tests it by a definite method, and finds no evidence of it and he gives a certificate on that finding?—That is quite true.

5889. (Dr. Whitelegge.) He gives a certificate of freedom from arsenic or practical freedom from arsenic, whatever it may be, and it is useful to us to see what it is that he represents. You will let us have a copy?—Certainly. But I think you ought to get it from a maltster.

5890. (Dr. Whitelegge.) Have you had any difficulty in obtaining certificates with the malt you receive?—Inasmuch as I do not buy the malt, from my personal knowledge I can make no definite statement on that matter.

5891. You are not aware of any?—I do not buy the malt myself. As far as I understand your question, a certificate is required; the maltsters have to certify, but the difficulty of getting a certificate of absolute purity from the maltster, I have been informed, is so great that it is almost impossible to get them from any maltsters in England.

5892. So that we must expect to find the certificate you are going to let us have will stop short of absolute purity. In your printed *précis* you mentioned that a number of samples of beer in stock were examined; can you say how far back that would carry you?—Some of these samples were the brews of January twelve months, and then they came down as far as the current brews.

5893. (Mr. Cosmo Benson.) I think we have had pretty nearly the whole of your experience as regards malt, but have you tested the other ingredients of brewing, preservatives, and so forth?—Certainly.

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Malt examined for arsenic before purchasing.

Form of guarantee given by maltster,

does not specify absolute freedom from arsenic.

Preservatives tested for arsenic.

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5894. They have all been tested for arsenic?—Most carefully.

5895. You mentioned hops; I presume the hops were bought before the scare was known, and you did not ask for a certificate?—Certainly not—not at that time. We do ask for a certificate that they are free or practically free from sulphur.

5896. That has been also since the scare?—No; we have been doing it for ten years. As far as we possibly can we buy no hops containing free sulphur.

5897. (Sir William Church.) Do you test for that chemically or judge by the nose?—We test for it chemically. I have not published the method, but we eliminate the crystals and practically re-crystallise the sulphur out of it, and examine it microscopically.

5898. I asked you, because we have had the question answered by others, who say they can always detect the sulphur in hops by smelling?—The sulphur they smell is not free sulphur. It is combined sulphur; the sulphur of the washes or the sulphur put on the kilns during drying.

No sugges-
tion that
flaked malts
and grits con-
tained
arsenic.

5899. (Mr. Cosmo Bonsor.) We are all aware there are other substitutes for malts used besides sugar, like flaked malts and grits; is there any suggestion that there has been any arsenic in them?—I have never heard of it.

5900. Should you be satisfied if the same Government inquiry were to cover the question of a standard for these things as well as regards malt?—Certainly. What I have said applies to the whole of the ingredients used in the manufacture or to the product.

5901. In plain language, you think that there need be no practical traces of arsenic in beer, the word "practical" to be defined by a Government authority?—That is my meaning, but of course the great difficulty comes in on the question of "practical."

5902. But we get rid of that difficulty by throwing the responsibility on to an authority who can vary it from time to time as knowledge comes?—Quite so.

5903. (Sir William Hart-Dyke.) With regard to hops, of course the quantity of hops used is very small compared with malt in brewing?—Certainly.

(SIR WILLIAM HART-DYKE in the Chair.)

5911. (Professor Thorpe.) The Commission, I think, would like to know something more in detail as to the last matter in your *precis* to which you draw attention, namely, the question of the particular method which you would suggest as to how these standards or determinations of what I may call limiting values in the amount of arsenic in beer or in similar materials could be arrived at?—My ideas in these matters are these. The described knowledge of the method by which these minute quantities are determined so vary amongst themselves, that in the face of such a condition of things it seems to me absolutely necessary that this Commission or some authoritative part of it should see that the point is investigated, on some definite and distinct lines. As you know, you have taken up determination of one of the constituents of butter, and three or four men who had knowledge of the matter came to the conclusion how it was to be done, and when the product under consideration was to be considered right.

5912. You are alluding to an action which was taken in my capacity as head of the laboratory to agree with the analysts as to what particular factors should be taken to determine a particular point. Is that strictly analogous?—I think so.

5913. In that particular instance to which you make allusion we had to put into effect a clause in a particular Act, and it was necessary to devise certain experimental conditions to give effect to a statement in that Act. There is nothing here analogous to that?—I quite agree with that. The committee of investigation, or whatever it might be, could act in a similar way. I think it can be distinctly proved that from time immemorial beer must have contained a certain amount of arsenic, and if a man asks for beer and is supplied with an article containing this amount of arsenic, whether he knows it or not, it cannot be asserted that he did not get an article of the nature and quality demanded. That is now the matter already concerns an Act of Parliament.

5914. What is in your mind is this, that you assume that samples will be taken under the provisions of the

5904. Could you off-hand give the Commission, taking an 18 gallon cask of beer, the amount of hops used?—There is no difficulty about that at all. Taking pale ale as an example; in 18 gals. of it there is, broadly, the extract of 40 lbs. malt, the amount of hops being 24 lbs. in the same bulk.

5905. Therefore, although you indicate in your evidence the possibility of a small portion of arsenic being found in hops, yet the risk from it would be infinitesimal?—Absolutely so.

5906. And you would rather wish to confirm what has been upheld by other witnesses, that the danger of arsenical poisoning as regards hops is very remote now, if not impossible?—That is so.

5907. And the two chief points you really wish to indicate as regards malt are the very great care with regard to the material used for fuel, and the special care with regard to the cleansing of the malt after wards?—That is so.

5908. And further, I think by the evidence you have given you do not think the question should rest altogether there, but some standard might be applied for the sake of future security?—That is my meaning.

5909. Both as regards the beer and as regards malt?—Yes, and all other foods. It would be a most grievous thing to keep the brewers of the country in the condition in which they have been for the last six months. It becomes an impracticable condition of things; everything is examined, everything has to be determined, and then there is the unsecurity of the results which some ales may give; for instance, your chemist may find a 1-200th of a grain to a gallon, and another finds 1-50th. How can you explain that? These are questions that will continually crop up and keep the brewer and brewer's chemist in such a condition that life will be fairly intolerable to him.

5910. You think, therefore, that the process by which this standard should be arrived at should be determined after very careful inquiry?—That I am satisfied about. The broad lines of the investigation are very well established. They want to be carefully worked out and put into a concrete form, every definition well described, so that no man could make a mistake over a question.

Food and Drugs Act, and that the allegation will be made that inasmuch as it contained arsenic it was not of the nature, substance, and quality demanded?—Yes.

5915. And what you want is provision to be made where the line is to be drawn?—Yes. Go back upon the old samples of beer, establish the amount of arsenic they contain and determine the value of the evidence there is to show the extent, if any, of the injurious effects attributable to them. Working on these lines I maintain it is perfectly open to such a Commission to lay down standards that would be workable and available.

5916. Do you propose that this Commission should do this?—Or a Sub-Commission appointed by this Commission.

5917. Your point being that this Commission should address itself to this particular point in a clause of the Act of 1875, namely, to define when the beer is not of the nature, substance, and quality demanded, *quid* the amount of arsenic which it contains?—I think that is broadly the question.

5918. How would you suggest that should be done?—I have not thought the matter out, but it seems to me such standards should go to the Government as a recommendation from this Commission, or that Government should be recommended to appoint a Special Commission of investigation of experts upon this one question alone.

5919. The reference of this Commission is very wide—it includes not only beer, but any article of food?—I know that is so.

5920. That would affect, of course, a great many interests. If the Commission set itself to work to satisfy the terms of its reference with respect to what you say it would involve a great many interests?—Naturally.

5921. What would be the constitution of the Sub-Commission which would handle this question, having regard to the occurrence of arsenic in food generally?—I cannot say anything about the large amount of labour it

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Quantity
hops used
beer.

Difficulty
brewers'
absence
authorities
tests for
arsenic.

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would necessitate, but when the general good has to be considered that labour must not be considered.

5922. Perhaps you would state to us in detail what kind of constitution this Sub-Commission should have?—I have nothing really in my head at the present time, but it seems to me that a Commission like the Pure Water Commission, of which you have a fair knowledge, would handle the matter with satisfaction.

5923. Should it be a Committee exclusively composed of chemical analysts?—I think broadly so, with a medical element.

5924. It should be a mixed Commission of chemists and medical men?—Yes. It is rather difficult to see where the medical men come in. If it was once granted there was a certain amount of arsenic permissible it would be for the chemist to say how much arsenic there is, and for the medical men to say whether it is injurious or not. But I say point blank, the medical men give us no evidence up to the present time that although beer must have contained arsenic from time immemorial they have been able to attribute any injurious effect from the arsenic in that beer.

5925. Your suggestion means that there should be a committee of analysts to prescribe methods for the detection and determination of the amount of arsenic in foods and in drinks, and that that commission should be associated with medical men to assist them in arriving at some defining limit as to arsenic which should be permissible?—That is not my proposition at all. My idea is that the first object would be to determine what was the nature and quality of the article under consideration from time immemorial, and if it were proved that upon the average beer, for example, did contain a certain small amount of arsenic, it should be the function of the sub-committee or sub-commission to define definitely how that quantity or proportion should be determined, and then, of course, it would be for the doctors to say, and for the Government to decide, whether it was permissible or not.

5926. But beer of the nature, substance and quality demanded would be a beer brewed from malt and hops, it may be, with or without glucose, but the malt might have been dried with arsenical coke?—Yes.

5927. That might be of the nature, substance, and quality hitherto demanded?—That is my contention; they would have to go back and determine what has been the condition of things.

5928. Is it your contention that that standard should be based on beer now discovered to have been brewed from malt containing arsenic derived from coke?—That would be one of my contentions.

5929. That we should be content with such and such an amount of arsenic?—No; that would come in a medical opinion. Observations would be made upon it to see how far that has been injurious, and how far it is likely to be injurious; there will come in the medical opinion.

5930. That is an unknown factor in our inquiry, as to how far injury to health has in times past been due to the consumption of arsenic?—I simply put it in this way, that as far as I have read in this evidence at the present time, until it was discovered some time

ago that beer was brewed from arsenical glucose, we had no evidence that any material injury was done to health by the use of beer from malt and hops alone, or with the addition of the materials that we are allowed by the Act of 1890.

5931. I think I understand what your contention is, and I express no opinion about that?—I know it is a very broad question and a very large question, and not having thought the matter out until you suggested it to me, I am not prepared to give that answer which I might if I had thought it out. But I do not think there should be any difficulty. Your contention is, that there is an Act of Parliament that helped you in the case of butter. There is an Act of Parliament in my mind to help you in this case too, and that if you were to satisfy yourself that this contamination has been present from time immemorial in this article of food, it would be for you to say, within what limits it should be permissible now.

5932. (Sir William Church.) When you say from time immemorial, there would be no arsenic until coal was used for drying malt, and I presume that until comparatively speaking a short time ago the greater bulk of malt was dried with wood?—With charcoal.

5933. (Mr. Cosmo Benson.) The other Act of Parliament to which you allude, I suppose, is the Act of Parliament of 1888, which gives the Excise power to stop any deleterious matter going into the beer?—No, that is not what I have in my mind. I think Dr. Thorpe understands what I mean. He had under the Sale of Food and Drugs Act to establish a certain fact, whether the article possessed such properties as to enable it to be declared a genuine article or not. I say the same thing applies to beer. This beer has been sold as an article of food for centuries, we will say, and that it must have contained arsenic. Therefore it would be difficult to say—

5934. (Professor Thorpe.) Pardon me. It can only have contained with certainty arsenic since coal or gas coke have been used?—Coal has been used for a long time—two or three hundred years or more.

5935. (Mr. Cosmo Benson.) But you are aware of that particular clause in that Act which gives the Board of Inland Revenue absolute authority to stop deleterious articles?—That is so.

5936. I presume arsenic in large quantities is deleterious?—That is where the large quantities come in. There is no doubt the Inland Revenue have, under that portion of the Act, absolute authority to prevent the use of glucose containing what they may consider deleterious quantities of arsenic. I am not quite sure even now that if Professor Thorpe found one-thousandth of a grain to a lb. in the sugar that he would not have the power of stopping it.

5937. Or in malt?—In malt or in sugar, because it would come to the question of how far it is deleterious.

5938. (Professor Thorpe.) I have not that statutory power. What you really drive at is that we should, somehow or other, by machinery, get that statutory power?—That is so.

5939. Have you anything more to say on the broad question?—No.

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(Sir WILLIAM CHURCH in the Chair.)

Sir LAUDER BRUNTON, called; and Examined.

Sir
Brunton

5940. (Sir William Church.) I believe you are a Fellow of the Royal Society, and physician to St. Bartholomew's Hospital?—I am.

5941. And you have made a particular study of therapeutics?—I have.

5941*. You studied the recent epidemic, and were a member of the Expert Committee of the Manchester Brewers' Association?—Yes.

action
senic.

5942. You are prepared, I think, to give the Commissioners an account of the action of arsenic upon the human system as observed during the recent epidemic?—Yes. If I may be permitted to give a short account of the general action of arsenic upon the body, I think I may be able to classify the symptoms observed in the present epidemic of arsenical poisoning so as to render it easier both to remember them and to understand the

varieties which have been described. Arsenic belongs to the same chemical group as nitrogen, which not only constitutes nearly four-fifths by volume of the atmosphere, but is an essential ingredient of all living tissues, and may be called the pivot on which all life turns. Other members of the group are phosphorus and antimony, both of which have an action very much like arsenic in many respects, and phosphorus, like nitrogen, is an important constituent of the healthy body. It is not certain whether arsenic acts by replacing nitrogen or phosphorus in the living tissues, and especially in protoplasm, which is one of the most important constituents of nerves, but it appears to have the power of altering the chemical changes or metabolism which occurs in them during life, and on which their function depend. In minute doses it appears to be beneficial, but in large doses it is poisonous, and will

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destroy both animal or plant life, so that in large quantities it will produce in man or animals irritation and inflammation of any part of the body on which it may be applied. This application may be made directly to a part, or the arsenic may reach it through the circulation. Thus, arsenic, when it is swallowed, reaches the stomach and intestines by direct application, and by irritating them produces vomiting and purging. In the form of dust, as from wall paper, or in making artificial flowers, it may enter the eyes, nose and air passages, and, thus, it may produce conjunctivitis, nasal and respiratory catarrh, and cough; or it may be applied directly to the skin and cause irritation and eruptions upon it. If much diluted it may produce little or no local irritation of the stomach, intestines or respiratory passages, but from these it may be absorbed by the blood, and carried by the blood to every part of the body. When absorbed from the stomach and intestines it is obliged to pass through the liver before it can enter the general circulation, and consequently the largest amount of arsenic is usually found in this organ after death from arsenical poisoning. Whilst circulating in the blood it may act on the heart, muscles and nerves. But it is not carried by the blood only to these organs, for through the circulation it goes a second time to the stomach, intestines, respiratory passages and mucous membranes of the eyes and skin. By these organs it is eliminated, and during the process of elimination it may again give rise to irritation in them just as it would do if directly applied. Moreover, John Hunter, Sir Everard Home and Sir Benjamin Brodie have shown that when arsenic is applied to a wound it produces more violent and more immediate inflammation of the stomach than when the poison is administered internally, and that this inflammation of the stomach precedes any appearance of inflammation in the wound (Phil. Trans. 1812, Pt. 1, pp. 209-210). Brodie concludes that "it may be inferred that arsenic, in whatever way it is administered, does not produce its effect even on the stomach until it is carried into the blood." This conclusion is perhaps too sweeping, and not strictly true for arsenic in large doses and in a concentrated form, but it is probably quite correct when the poison is taken in moderate or small doses, and in a diluted form, as in the beer at Manchester. Whilst circulating in the blood arsenic is carried to every organ and tissue of the body, and affects markedly the nervous system and muscles, the mucous membranes and skin. It begins to be eliminated by the kidneys within a few minutes of its absorption, and is also eliminated by the mucous membranes and skin. If only small doses are taken daily the whole of the poison may probably be daily eliminated, and it may be taken for months without any harm. But if the doses are larger, less is eliminated daily than is absorbed, and it becomes stored in the body and produces symptoms of poisoning. During the process of elimination it irritates all the mucous membranes and the skin, and produces corresponding symptoms. By irritating the mucous membrane of the stomach it causes loss of appetite, nausea, vomiting and epigastric pain. In the intestine it produces colicky pains and diarrhoea. By irritating the respiratory tract it gives rise to coryza, cough, hoarseness, huskiness of the voice, oppression of the chest, retrosternal pain and bronchitis, with occasional hæmoptysis. In the eyes it causes irritation, conjunctivitis and oedema of the eyelids. In the skin it produces all sorts of eruptions, nettle-rash, redness, papules, pustules, vesicles and boils. Three of the most marked are pigmentation, herpes, and a condition to which the name of keratosis has been given in which the epidermis peels off the palms of the hands and soles of the feet in large flakes. Keratosis is probably due to the local action of arsenic upon the skin; for Ringer and Murrell found that in frogs poisoned by it the cuticle could be readily stripped from the body, and Nunn showed that this is due to softening of the protoplasm in the epidermis, so that it becomes almost completely detached from the dermis. The herpetic eruptions, as well as loss of hair, brittleness, or shedding of the nails, excessive sweating and subcutaneous oedema, however, are probably dependent rather upon the action of arsenic on the trophic or nutritive nerves of the skin to which reference will afterwards be made. During its circulation in the blood arsenic acts on the muscles of the limbs, on the muscular fibre of the heart, on the liver and other glandular organs, and especially upon the nerve trunks, although it acts, also, to a small extent on the spinal cord and brain. It thus tends to cause anæmia, as well as fatty degeneration of the muscles and of the heart, so that the limbs become

feeble, and the heart so weak that death may occur from its failure. The liver also undergoes fatty change. The nervous system, and especially nerve trunks, are especially attacked by the poison. Nerve trunks usually contain fibres having three different functions, namely sensory, motor and trophic or nutritive, and all those functions are altered by the inflammation which arsenic produces in the nerve trunks. The alterations are of two kinds; first, the nerves are unable to do the things they ought to do; and, secondly, they do things they ought not to do. The sensory nerves instead of conveying definite impressions to the brain become dulled, so that the patient does not feel external objects with the same accuracy that he or she ought, and in consequence complains of numbness, and may be unable to distinguish where or what things are, and may thus, for example, be quite unable to sew, or even to write, and may drop things from the hand unwittingly, while the patient may feel as if his feet were walking on wool instead of on the floor. At the same time, the sensory nerves convey to the patient impressions for which there is no real objective ground. He may feel as if pins and needles were running into him, insects were running over him, or he may feel intense burning or pain of all sorts in various parts of the body, and both the skin and the muscles may be so abnormally tender that the slightest touch or pressure is not felt as touch or pressure, but causes the most intense suffering. On account of the weakness of the motor nerves the patient soon gets tired, and then certain muscles become so weak as to act only imperfectly, or may become completely paralysed, and not act at all. On this account the gait becomes feeble and staggering, the feet drop, the hands drop, the patient becomes unable to walk or stand, and may be even unable to feed himself, while on account of the diaphragm being weak or paralysed the respiration becomes feeble and imperfect. By stimulating the trophic or nutritive nerves, and perhaps by directly altering the tissue change of the parts themselves, arsenic may at first appear to increase nutrition, so that small quantities render animals or men taking it plumper and more active, their hair grows more thickly, and their skin appears clearer than before. But if this point be overpassed, the animals or men become thinner and wasted, the skin dry and hard, peeling off in scales, and often much pigmented. This pigmentation varies in appearance. It is sometimes slight but general, sometimes patchy, and sometimes so generally diffused and deep in colour as to make the patient appear to belong to a dark-skinned race. The peeling of the skin generally occurs in bran-like scales, but the epidermis may separate from the soles of the feet and palms of the hands in very large flakes. To this the name of "keratosis" is given. Local swellings of an oedematous or dropsical nature may occur in various parts of the body, and are particularly noticeable in the eyelids. The spinal cord may also undergo alteration, and some of the neuralgic pains, the loss or perversion of sensations of heat or cold, loss of reflexes and want of co-ordination in movement may be partly due to alteration in it, as well as to alteration in the nerve trunks. In some cases, although rarely, the brain has been found to be affected, and symptoms of melancholia or mania have occurred. The nervous ganglia of the heart may be weakened, and this, along with the feebleness of its muscular fibre, already mentioned as due to arsenic, may lead to syncope, or even to death. The nerves which regulate the contraction of blood vessels are said by Böhm to be paralysed by large doses of arsenic, so that the vessels dilate, especially those of the abdomen, and this, along with the weakness of the heart, explains the low tension of the pulse observed in severe cases during this epidemic. The blood vessels of the soles of the feet and of the palms of the hands become much dilated, so that the skin of these parts towards the outside becomes very red, and at the same time it becomes exquisitely tender and very painful. This condition is known under the name of erythromelalgia.

5943. Do the symptoms vary with the amount of arsenic taken?—All the symptoms I have mentioned may occur in chronic arsenical poisoning, but they may not all appear in the same person or to the same extent, for their occurrence may depend upon the quantity of arsenic they have taken, upon the length of time its administration is continued, upon the form in which it is taken, and upon the personal peculiar idiosyncrasy of the person taking it. Small quantities of arsenic, such as the 50th to a 10th of a grain, may be taken by many people for months together with no apparent bad health, but, on the contrary, with better

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Fatty
change.

Neuritis.

Paralysis.

Pigmen-
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Oedema.

Eryth-
ragia.

Individ-
suscept-
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arsenic.

Elimination
of arsenic
from the body
and its
results.

keratosis.

Herpes.

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nutrition and increased strength. In these cases it is probable that the whole of the arsenic is eliminated daily as quickly as it is taken, and that there is no storage of it within the body; but if larger quantities are taken, so that the whole is not eliminated, it will gradually accumulate, and symptoms of poisoning begin to occur, which may become very severe or fatal. Yet, if the administration of the drug be stopped before a fatal issue is reached, the poison which has already been stored up in the body is gradually excreted, and the patient may recover even when apparently at death's door. But during the process of elimination symptoms of sub-acute poisoning may occur, and the arsenic which has been stored up for awhile in the body may, in passing out through the mucous membranes of the intestine and stomach, irritate them and produce vomiting and purging, as in some of Mr. Dixon Mann's cases three weeks after the arsenic had ceased to be taken.

5944. Are some persons so constituted as to bear larger doses of arsenic than others?—The effect of arsenic can be modified by the age, strength, and constitution of the patient taking it, women usually being able to take less than men, and children very much less than either. Susceptibility to arsenic varies very considerably, and while three minims of Fowler's solution, which is a 1 per cent. solution of arsenic, and is the preparation commonly given in medicine, will sometimes cause such symptoms of intestinal irritation as will necessitate its discontinuance, other patients will take 30 minims, or even more, three times a day without any discomfort whatever. The way in which it is given alters its action, so that if five minims of Fowler's solution were given on an empty stomach three times a day it would probably produce irritation of the stomach and intestines, whereas if given when the stomach was full it would be diluted by the food and be absorbed without producing any local irritation whatever. When much diluted in the form of beer, the local action of arsenic on the stomach and intestines at the time of taking it is probably very slight, and the gastro-intestinal irritation observed during this epidemic was comparatively trivial as compared with the other symptoms, and was probably due to irritation of the mucous membrane occurring during its elimination. During the circulation of arsenic in the blood, it is not improbable that its action may be determined to one part of the body or to another by other substances taken at the same time. A well-marked instance of this kind of action is known in the case of mercury. Alcohol is well known to have a strong affinity for the nervous structures in the body, whilst that of mercury is much less. But alcohol seems to direct mercury to the nervous system, and cause it to act upon them. An example of this is given by the fact that during the preparation of an alcoholic compound of mercury, called mercuric methide, two chemists who were subjected to the fumes were poisoned by the compound, and showed signs of nervous disease, one of them becoming maniacal and dying within three months, and the other becoming idiotic, and dying after about a year's confinement in a lunatic asylum. Osler has observed that mercury taken along with alcohol seems to have more tendency to produce peripheral neuritis than if taken alone, the alcohol seeming, as it were, to direct the arsenic to the nervous system. If the statements made by some of the patients who have suffered in the present epidemic of this arsenical poisoning as to quantity of beer they have taken are correct, the amount of arsenic consumed in some cases must have been so exceedingly small as to lead one to ask whether the neuritis can be due to arsenic alone, even though its action may have been directed to the nerves by alcohol or hops, or whether some other poison besides arsenic has not been present in the beer, or whether the arsenic is not present in such a combination as to have a much more deleterious action than that of pure arsenic itself. There are difficulties in accepting the statements of some of the patients as correct, for in the case of Alice Booker, which terminated fatally, and in which Dr. Stevenson separated a weighable quantity of arsenic from the viscera, the patient only admitted having taken less than one pint per diem. It is quite possible that arsenic may be present in beer, combined with either a hydrocarbon or with a proteid, for although it is said not to unite with albumen to form an albuminate, it has been found to enter into combination with casein. At present, however, this is only a hypothesis, and Professor Hewitt and I are at present engaged in investigating the subject. It is, however, a research full of difficulties, and if we succeed in obtaining definite

results at all, it will probably not be until after the expiration of several months at the earliest.

5945. Do you know of any other facts bearing on the hypothesis you have just mentioned?—Yes. In an epidemic of arsenical poisoning at Würzburg, where the arsenic was contained in bread, only one case of paralysis was observed in 373 cases of poisoning. This extraordinary want of action on the motor nerves when taken in bread as compared with its action when taken along with alcohol in beer or wine tends to substantiate my hypothesis.

5946. Have you any doubts as to the epidemic in Manchester being due to arsenical poisoning?—I have heard doubts expressed as to whether the epidemic in Manchester was due to arsenic at all, and I confess that when I first went I thought that possibly the symptoms might be caused by organic impurities in beer, such as some of the higher alcohols, e.g., fusel oil, by albumoses, or by furfural. But an examination of the facts has convinced me that the epidemic was due entirely, or almost entirely, to arsenic. No doubt neuritis may be produced by toxins of an albuminous nature, such as occur in the body in diphtheria, in plague, and in beri beri, or are found outside the body in diseased grain, such as ergot and maize, producing ergotism and pellagra. But in the present epidemic the cases of illness were distinctly traced to beer. There was no diseased grain used in its production, no evidence of any infective disorder; in fact, there has been no evidence of the presence of anything excepting arsenic, and possibly selenium, that would produce the symptoms. These symptoms consisting in a combination of gastro-enteric irritation, peripheral neuritis, pigmentation, and eruptions of the skin, are almost characteristic of arsenical poisoning. They occurred in previous epidemics. For instance, in the one which occurred in Hyères, in which a number of persons were poisoned by arsenic in wine, the symptoms were almost identical with those of the present epidemic. In both these epidemics the symptoms may be conveniently classed in the manner adopted by MM. Vidal and Ollivier for those observed at Hyères into:—

- (1.) Digestive.
- (2.) Cutaneous.
- (3.) Nervous.

In both epidemics the digestive symptoms were not nearly so prominent as would have been expected from the well-known irritant action on the digestive canal which arsenic produces in cases of acute poisoning, and in some cases symptoms of this sort were completely absent. They seem to have been rather more marked at Hyères than at Manchester, a circumstance which one would naturally expect both from the more irritating action of wine as compared with beer on the mucous membrane of the stomach and intestine, and from the larger proportion of arsenic in the wine (.08 gramme per litre). The digestive symptoms were alike in both epidemics, viz., loss of appetite, vomiting, abdominal pain, and diarrhoea. Retrosternal constriction or pain was noted in both, and I have mentioned it already along with cough, but at Hyères it was attributed to digestive derangement. In both epidemics the symptoms produced during absorption were slight in comparison with those which occurred during the circulation of the poison in the system and during its elimination.* The cutaneous symptoms which occurred were of the most varied kind in both epidemics. In Hyères the forms were so manifold as to exhaust dermatological nomenclature, and they were no less so in Manchester.† In both epidemics two of the most striking cutaneous symptoms were pigmentation of the surface generally, and separation of the epidermis from the feet and hands in such huge flakes that it seemed as if the whole skin of the soles and palms came off in one piece (keratosis). At Hyères coppery patches on the skin and an eruption of the colour of burnt coffee were noticed, but the pigmentation does not appear so have been so dark or so extensive as in some of the cases at Manchester. In both epidemics the nervous

* MM. Vidal and Ollivier say "Les ingestions répétées de doses dissimulables, mais relativement élevées, d'arsenic n'ont été suivies que d'accidents peu importants correspondant à la période d'absorption: les plus sérieux se sont montrés pendant la diffusion dans l'organisme se surtout l'élimination. Bull. de l'Acad. de Med. 1888, T. xx, p. 624.

† According to M.M. Vidal and Ollivier "Si l'on voulait donner un nom adapté exactement à la forme de toutes ces éruptions il faudrait épuiser la nomenclature dermatologique actuelle. Bull. de l'Acad. de Med. 1888, xx, p. 623.

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Difference in
symptoms
between
arsenic
poisoning
from beer
and from
bread, as in
Würzburg.

Symptoms of
Manchester
cases like
those in
Hyères due
to arsenic in
wine.

Great variety
of skin
affections.

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symptoms were the most important, and in both cases they were at first attributed to alcohol and not to arsenic.* In both epidemics, although numbness and loss of sensation were observed, they were not such prominent symptoms as pain and tenderness, weakness and paralysis. In both pain was a most marked feature, varying in intensity from slight "pins and needles" to most intense agony; and a very striking symptom was extreme tenderness to touch or pressure, so that the patients could not bear the pressure of the bedclothes on their limbs. Extreme tenderness of the calves and other muscles of the body on pinching, as well as the redness and exceeding painfulness of the soles of the feet and palms of the hands (erythromelalgia), which were so marked in the Manchester cases, are less prominently noticed in the accounts of the Hyères epidemic. Something of the same kind seems, however, to have been present for the patients are said to have complained of pain as if dogs were gnawing their calves and the soles of their feet. In both epidemics the muscular weakness or paralysis, the difficulty in walking, the peculiar gait, and sometimes the complete inability to stand, were all alike. Both resembled each other, also, in the affections of the respiratory system; indeed, with the slight difference indicated already, the symptoms in one epidemic might stand for those of the other. In both epidemics there can be little or no doubt that the symptoms were chiefly, if not entirely, due to arsenical poisoning, for (1) there was an absence of any other sufficient cause, (2) there was sufficient arsenic to cause symptoms of poisoning, (3) the symptoms corresponded with those which have been observed in cases of chronic poisoning by arsenic taken in other ways.

5947. Then you have no doubt in your mind that the recent epidemic was due to arsenical poisoning?—When I first went to Manchester to investigate the epidemic I started with the idea that the symptoms of poisoning were probably due not to the arsenic in beer, but to some other impurity, but I soon found that the arsenical origin of the epidemic could be proved beyond a doubt. The present epidemic is certainly due to contamination of beer through glucose and invert sugar made by one particular firm, who had been supplied with sulphuric acid containing a very large quantity of arsenic. The extraordinary number of cases of peripheral neuritis which have occurred in this epidemic, together with the fact that this disease has been specially observed and described by two Manchester men, Professors Ross and Dreschfeld, naturally raises the question whether the peripheral neuritis, a disease which is commonly attributed to alcohol, is not caused in most, if not in all, cases by arsenical poisoning, and whether poisoning by arsenic may not have been going on to a greater or less extent in Manchester for many years. A good deal may be said on both sides of this question. On the one hand, it cannot be denied that peripheral neuritis may be caused by toxins, for it is found in diphtheria, where no poison except that of diphtheria has gained access to the organism, and Sidney Martin has shown that the diphtheritic toxins, apart from the bacillus, will produce neuritis in animals. But, on the other hand, although it is commonly supposed that alcohol will cause the disease, it is by no means certain that ethylic alcohol will do so, and alcoholic neuritis in spirit drinkers may possibly be due to other substances than ethylic alcohol. A remarkable observation was made to me in a letter by Sir William Gairdner. About sixteen years ago he was examining in Manchester, and went through the wards of the late Dr. Ross. He saw there several cases of peripheral neuritis, and was much astonished because he could not recollect seeing more than two cases in Glasgow in all his life. He wondered if he could have overlooked the disease, but after consideration he came to the conclusion that it did not exist in Glasgow, notwithstanding the large quantity of whisky which was drunk there, and ought to have produced the disease if it were due to alcohol as usually supposed. The fact that arsenic has now been found both in hops and malt renders it not improbable that cases of peripheral neuritis in Manchester may for years past have been due to a certain amount of contamination of beer by arsenic through hops and malt, and although it is not yet certain, it seems probable that this contamination may have arisen from the use of coal or coke containing arsenic in the process of drying.

5948. Have you anything to say with regard to the recent discovery of selenium in beer?—The recent and

More information needed as to selenium in beer.

* "Jusqu'au 20 mars," dit le Dr. DuBrandy, "j'avais toujours supposé que les accidents pourraient bien être d'origine alcoolique et produits par l'usage d'alcools absorbés en nature ou sous forme de vins viciés en excès." Bull. de l'Acad. de Med., xx, p. 620.

remarkable discovery of selenium in beer by Professor Tunncliffe imports a new factor into the question, but further information is required before any conclusion can be arrived at as to whether this substance may be partly to blame for producing neuritis, and if so, to what extent.

5949. You wish to make some observations on objections which have been raised to the practice of using glucose in brewing?—The occurrence of this epidemic has caused an outcry against the practice of using glucose and invert sugar in brewing, and a demand that only barley and hops shall be employed. But I am informed that this would render it difficult to brew the light beers similar to the German lager or Pilsener beers which have come to be so extensively drunk in this country within the last thirty years. I regard the introduction of such light beers as a benefit to the public, for it supplies a drink which can, if pure, be taken without causing the heaviness, drowsiness, stupidity and headache which so commonly follow the consumption of heavy ales.

5950. And you wish to indicate that indirectly the recent epidemic may have given a useful lesson?—Although this epidemic has done much harm, has caused great pecuniary loss to the brewers, who were not to blame, and, still worse, has caused great pain, paralysis, and, in some cases, death to the unwitting consumers of the contaminated beer, it has not been without its advantages. For it has shown how a poisonous substance may find its way into a chemical, and, through it, not only into beer, but many other substances used as food. It has shown, also, how a poison like arsenic may find its way into food in such unexpected ways as through hops and malt, and thus enforces the necessity of guarding the consumer not by placing restrictions upon manufacture, but by demanding that the manufacturer shall in the future be held responsible for the purity of the articles he sells, and that all materials for beer or foodstuffs should be sold with a guarantee of purity which should be rigorously enforced.

Food manufacturer should be responsible for purity of his products.

5951. With regard to what you say as to the action of arsenic when it is applied to wounds and external inflammations, is it not the case that arsenic coming into contact with the skin of those who are working in preparations of arsenic of itself produces very troublesome sores?—It does.

5952. Is that due to external application, and not to its having been absorbed?—No, to its local action. I have noted that it may be applied directly to the skin, and cause irritations and eruptions upon it.

5953. You say that the liver also undergoes fatty change. Of course in this epidemic there has been a mixture of alcoholic poisoning probably with arsenical poisoning?—I think in all the cases that I saw in Manchester the symptoms were mixed—partly alcoholic and partly arsenical.

5954. Would you mind telling the Commission a little more with regard to the changes that you think arsenic produces on the liver?—The liver cells undergo fatty degeneration. The substance of the cells themselves are more or less converted into fat. In cases of alcoholic degeneration you will very often find a greater enlargement of the liver than with arsenical poisoning, apparently more deposition of fat; not so much conversion of the protoplasm of the cells into fat, but an absolute deposition of fat from elsewhere.

5955. In very chronic cases of poisoning with either substance there are further alterations which you think differ in the two cases?—In the case of alcoholic poisoning one generally gets a large deposition of fibrous tissue, giving rise to hardening and afterwards to a contraction of the liver, the fat being absorbed. I do not know that this is observed to anything like the extent, or has indeed ever been observed to any extent, in cases of arsenical poisoning. Most of the observations on the action of arsenic on the liver have been made upon animals, and of course in them the poisoning is carried out quickly, and there is not the same time for observation that there is in cases of alcoholic degeneration of the liver in man.

5956. So that we really know very little with certainty with regard to the action of arsenic upon the liver when carried on for long periods of time?—Very little.

5957. Could you tell the Commission anything with regard to Dr. Dixon Mann's cases, where three weeks after the arsenic had ceased to be taken, irritation of the stomach and intestines took place? Do you know whether any examination of the urine was made at that

time, whether it was really certain that arsenic was passing out of the body at that time?—I regret I cannot state definitely. These cases were described by him at a meeting of the Royal Medico-Chirurgical Society. He made the statement very positively that there were cases of arsenical poisoning, but I cannot at this moment recollect whether, during the time when the symptoms were developed, arsenic was observed in the urine or not.

5958. Would that not be a proof that arsenic was really being eliminated at that time, whereas this is only an inference from the occurrence of the purging and vomiting? Some persons are so constituted as to bear larger doses of arsenic than others?—Yes.

5959. And the effect of arsenic, as you say, can be modified by the age, strength, and constitution of the patient taking it, women usually being able to take less than men, and children very much less than either—that is, when arsenic is given medicinally?—Yes, when one knows definitely that the patient is taking arsenic, and knows the exact amount that is given.

5960. Is it generally recognised, that women can take less than men, bulk for bulk of body?—I should not say bulk for bulk. This is only a general statement of men compared with women, and not men and women as compared by body weight.

5961. Or children?—Children I do not think stand it nearly as well. Some of them do, but children, as a rule, do not bear arsenic so well as grown-up people. The intestines seem to be more irritable, and the proportionate dose is very apt to cause pain and diarrhoea.

5962. Does the susceptibility of different children vary very greatly?—Enormously, I think.

5963. Is that the only reason that you can advance for women having apparently suffered more severely than men in this epidemic?—No, I think it is that the women have really taken more beer, and that possibly the women have been supplied always with the same kind of beer—that they have gone to a public-house near at hand, so that where they have taken arsenical beer they have taken it continuously. A man moves about and perhaps drinks arsenical beer at one public-house, non-arsenical at another, and so on. So that the two reasons, I think, are that the women have actually drunk more beer than the men, and that they have drunk regularly beer containing arsenic, whereas men who have drunk a good deal may have had a mixture of beers.

5964. Do you think that the greater physical labour of the men leads to more rapid elimination of the arsenic?—That is possible, but I do not know.

5965. Have you any information to give the Commission with regard to the work that you are carrying on with Professor Hewitt which you alluded to?—We find it an exceedingly difficult problem. We have tried to obtain from beer arsenical products, but they are so exceedingly difficult to obtain, and so exceedingly difficult to settle their constitution, that we are thinking of beginning really from the other end, and of trying to obtain arsenical substances which may be possibly present in beer. For example, we think of trying to obtain arsenical ureas in which the nitrogen of the ureas should be replaced by arsenic and several other compounds of that sort. If we succeed in those we may possibly go on to try and obtain arsenical albumoses. But the substances present in beer are certainly very complex, and we have not come to any definite conclusion as yet.

5966. Have you any evidence that arsenic is present in the beer in a complex organic condition?—There is no definite evidence yet. The reason for supposing that it may be so is this, that in the case of epidemics where the arsenic has been taken in alcoholic liquids there has been much more affection of the nerves. In one case, for example, where a large number of cases occurred from arsenic taken in bread, the nerves were not nearly so much affected.

5967. That possibly may be explained by the joint action of the two bodies together, without imagining that they form a new body?—That is quite possible. As I said, it is possibly determined by the action of the alcohol.

5968. Have you any doubts as to the epidemic in Manchester being due to arsenical poisoning?—None whatever.

5969. Recognising now that it was due to that at Manchester, would you mind stating whether you think there were any reasons why the doctors at first were

slow in recognising it?—I believe that for a number of years cases of neuritis have occurred in Manchester.

5970. Would you anticipate that neuritis was the form of disease which would first attract attention in arsenical poisoning?—No. But the number of people suffering from alcoholic neuritis was supposed to be due to alcohol, and not to arsenic.

5971. That you have mentioned. I am asking whether anything has occurred to you to explain the delay of the profession generally in recognising that this disease in Manchester was due to accidental arsenical poisoning, and not to alcoholic poisoning or any other poisoning. During the early part of the epidemic, the great absence of sickness and diarrhoea amongst the people who were taking arsenical beer was noteworthy. The first symptoms that attracted attention were not gastric, which is usually the case in arsenical poisoning?—There is that, and their being familiar with cases of neuritis due as they supposed to alcohol. They therefore classed these cases, which might have otherwise attracted attention, as being due to alcohol. If I might put it in other words, their familiarity with alcoholic neuritis misled them because they attributed the neuritis always to the alcohol and to nothing else.

5972. Do you think it is a fact that alcoholic neuritis has been much more prevalent in Manchester, Liverpool, and the neighbourhood than in London and district?—I think it must be so, because it was in Manchester that the disease attracted so much attention. It was there very clearly described by Ross and Dreschfield, whereas men in other parts of the country had not seen the cases or else had passed them over. Sir William Gairdner, of Glasgow, told me that he had been examining in the Victoria University, and was much struck with the fact that there was not only one but two or more cases of peripheral neuritis in Dr. Ross's wards. It struck him all the more because he had not seen such cases in Glasgow. On taxing his memory he could not remember more than two at the very outside in the whole of his life, and yet people in Glasgow drank enough whisky to give them alcoholic neuritis if the neuritis was due to alcohol pure and simple. Although he could not explain this prevalence of alcoholic neuritis in Manchester at the time, on learning that people had been drinking beer containing arsenic, he went over the facts, and came to the conclusion that the neuritis he had observed was probably not really alcoholic but arsenical.

5973. The profession generally in London were quite conversant with what they call alcoholic neuritis in London?—Yes, but not to the same extent.

5974. That leads you to think that it is possible that arsenical poisoning has been going on for some time?—Yes.

5975. With regard to Professor Gairdner's remark, is it not true that apparently different alcoholic drinks do produce different changes in the tissues of the body?—I think it is quite true. I once came across rather a curious observation in regard to different kinds of wine, which was made to me by the landlord of a hotel, and not by a medical man. The landlord of the hotel of Les Avants, above Montreux, told me that the people in their own valley who drank white wine all became affected with tremor, so that they were obliged to give up their occupation, whereas the people who drank red wine in the same localities did not suffer in the same way. The actual explanation of that I have not been able to find out, but it was suggested to me that the white wine was often more or less sweetened with glycerine, and that the glycerine might possibly contain arsenic, and that those people who drank white wine might be suffering from arsenical tremor brought on through taking white wine sweetened with glycerine.

5976. Is it not the case that whisky does not seem to produce the same sort of degeneration upon the internal organs that gin does?—That is quite true, I think. For example, in the liver there is one variety of diseased liver which is known under the name of "gin drinker's liver," and which appears to be more marked in the case of those who drink gin than in those who drink whisky.

5977. It is comparatively rarely found in Edinburgh and Glasgow, or Scotland generally?—Yes.

5978. So that the mere fact of alcoholic paralysis not being so prevalent in Scotland may depend upon some unknown cause, just in the same way as cirrhosis of the liver is not so common in Scotland from alcohol?—Yes.

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Epidemic at first wrongly attributed to alcohol.

Greater prevalence of alcoholic neuritis in Manchester before the epidemic.

Dr. Ross and Dreschfield.

Glycerine in wine.

Sir
L. Branton. 5979. Do you think there is any widespread feeling against the practice of using glucose in brewing?—I do not think so.

26 Apr. 1901. 5980. Is glucose likely to be injurious when used in beer?—No, certainly not. It seems to me that glucose is one of the things about which you can be absolutely certain that it contains no arsenic.

5981. Do you think there would be any difference when the glucose or invert sugar was added in the copper in making the wort, or if it was added afterwards to the finished beer? There is a process which they call priming in which glucose is used?—I suppose that if it was added to the beer before fermentation some of it might be taken up by the yeast and thus removed from the beer.

5982. I mean pure glucose?—No, I do not think so.

5983. You think that pure glucose, used in brewing, if it is fermented, is perfectly wholesome?—Perfectly.

5984. And you think that the resulting liquid is equally wholesome if it is added after the fermentation has been completed?—Perfectly so. Glucose is a perfectly innocuous substance and an excellent food. The results would be different as regards the liquids. As regards the health of the person, they are both perfectly innocuous.

5985. It has been given in evidence before us by one medical man that he thought the beers brewed with glucose were not so wholesome, and more often led to vomiting and stomach troubles than those which did not contain a large quantity of glucose?—I know of no facts which would lead one to believe that. I cannot deny it, because I have not the data.

5986. You know nothing which would lead you to think that the addition of this unfermented glucose to the finished beer would be likely to cause the beer to be unwholesome?—No, except that in very large quantities sugar of any kind disagrees with some people, whether in the form of glucose or saccharose.

A Government Board of reference should control purity of food. 5987. Have you thought out at all in what way guarantees of purity should be rigorously enforced by the manufacturers in buying materials?—I think that practically we want in this country something corresponding to the German Gesundheitsrath, a Board of Public Health, and that such a Board should have at least one representative of various sections. One would require at least one man thoroughly acquainted with public health, and the management of public health affairs. You would want a thoroughly trained chemist; you would certainly want a bacteriologist; you would want a man to investigate the action of any poisons that might happen to turn up, a pharmacologist, and you would also want a medical man—five different representatives, and probably you would want instead of one of each, several.

5988. Several members?—Yes, several members of each section.

5989. With what bodies would this board be in relation, and how would it work?—I have not thoroughly considered the relationships of it; I have only thought that it would have to take cognizance of questions brought before it by public analysts and medical officers of health.

5990. It would be a board of reference rather than a board of action?—Yes.

5991. (Professor Thorpe.) With what Government department would it have relations?—Unless the Local Government Board were reconstituted it would come into relationship with the Local Government Board.

5992. (Mr. Cosmo Benson.) Would it be appointed by the President of the Local Government Board and discharged by him?—It might be so.

5993. (Professor Thorpe.) Take any particular case, boracic acid, on which you gave us evidence before the Committee. After taking evidence, and making such inquiries, suppose that this board came to the conclusion that the use of that particular antiseptic was injurious, what would follow on that finding?—Then instructions should be given to the medical officers of health that all cases where boracic acid was found should be prosecuted.

5994. Under what Act?—I should think the Sale of Food and Drugs Act would cover that, would it not?

5995. Not unless somebody had declared it to be a noxious and deleterious thing, and not of the nature, substance, and quality demanded?—The question whe-

ther boracic acid was a noxious thing or not would be referred to this board.

5996. If the board came to the conclusion it was, your idea is that they would recommend the Local Government Board to take action under the provisions of the Sale of Food and Drugs Act?—Yes. We must have some definite advising body to whom such questions could be referred.

5997. You have just drawn our attention to the Periphere different mode of action of different forms of commercial alcohol. You instance, for example, the difference in the mode of action of gin and whisky. I believe you have given some attention to the action of the aldehydes. Is it possible that the action may be in some way connected with the presence or absence of bodies of this character?—That I cannot tell. I thought at first it might be. When I went to Manchester I saw so clearly that it was arsenical poisoning and not connected with the aldehydes. One reason why I believe that it is not connected with the aldehydes is that in the epidemic of Hyères the symptoms resembled exactly those of the epidemic in Manchester, and the ordinary light wine of the south of France contains very little aldehydes.

5998. You quickly satisfied yourself in the case of the beer that it was due to the arsenic, because arsenic was found in relatively large quantities, and the symptoms corresponded to those produced by arsenic; but nevertheless, is it not possible that the continued ingestion of small quantities of furfuraldehyde is capable of producing peripheral neuritis?—That I cannot tell, because these are just the questions that at present there is no possibility of settling. At present the only way to settle such a question would be either to make a prolonged series of experiments upon animals, which would very likely give unsatisfactory results, and the other would be to let a number of people go on taking a kind of spirit which we know to contain aldehyde. But one point about the aldehydes is that they are present in Scotch whisky, and in Glasgow, where the whisky was taken for a length of time and in considerable quantities, and where we may assume—although, perhaps, we have no definite evidence—that all that time the people were drinking whisky containing furfural—probably they were, and did not get peripheral neuritis.

5999. Furfural would be most largely found in the newest whisky?—Yes.

6000. And it became eliminated by age?—Yes.

6000*. To it is due the physiological effect between aged whisky and new whisky?—Yes. In Glasgow I fancy they drink a great deal of new whisky.

6001. Does Irish whisky contain more furfural than Scotch whisky?—I fancy it does, but I do not know. I believe in Ireland there used to be a great deal of Irish whisky which paid no duty, and there was no separation between the alcohol and the impurities. The whole thing was simply distilled over, and that must have contained a large quantity of furfural.

6002. In illicit-made whisky there must be a large preponderance of furfuraldehydes and other aldehydes; but the amount of illicit whisky is so small that its influence as regards neuritis would probably not be detectable?—I hope so.

6003. (Dr. Whitelegge.) I did not quite gather whether you had any reason to think that arsenic in beer was probably not in the form simply of arsenious oxide?—No, I cannot say definitely. It is a hypothesis that requires to be worked out. As I said before, the practical research necessary to answer this question is an exceedingly difficult one. It takes a lot of time, and you get a great many disappointments.

6004. Have attempts been made by yourself or other experimenters to separate out the arsenic in whatever form of combination it exists, by dialysis, or in other ways?—Not by dialysis. Dr. Hewitt is working at the thing just now, and I cannot give you the data he has. But it has been more by precipitation.

6005. You referred to the difficulty that would arise in brewing light beers similar to German lager and glucose Pilsener, if glucose were disallowed? Am I right in supposing that glucose is not used in brewing those beers in Bavaria and other parts of Germany?—I believe that is quite true. It comes to be really an economic question. I only speak from hearsay. I was told that our barley contains a much larger quantity of nitrogenous substances than the foreign. That if we use malt made from British barley, without the addition of glucose to

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counterbalance the extra nitrogenous matter, we are bound to have a very heavy beer, such as was prevalent some thirty years ago. There are only two alternatives, we must either add glucose, or else we must go to Germany, or some place for the lighter barley to make malt with.

6006. So that the difference arises from the difference in the English and German barley?—That is so.

6007. I did not catch what you said was the difference between the malts?—The German barley contains a smaller quantity of nitrogenous matter. There is a larger proportion of starchy matter, and if we brew with English barley we get into the beer too large a proportion of nitrogenous matter, and to counterbalance this we must put in some extra saccharine, and if this is not done the other alternative is, we must go somewhere else and get a foreign barley from which to make malt, because the foreign barleys yield a smaller proportion of nitrogenous matter and a larger proportion of saccharine.

6008. You suggested the composition of a Board to pronounce an authoritative opinion on points in connection with the sale of Food and Drugs Act, not beer in particular, but foods in general?—Everything.

6009. Would you think of such a body as exercising any control over the processes of manufacture?—No, I think they had better not. It would be a great pity to interfere with the processes of manufacture.

6010. You suggested that the manufacturer should in

future be held responsible for the purity of the article he sells. You would not think of that as a function of the body you propose?—No. The Medical Officers of Health would get specimens of various articles, or if the purchaser complained of some product being impure, it might well be submitted to such a Board, and their decision upon it would be final, instead of as at present simply involving a lawsuit.

6011. Their opinion as to the harmfulness or the reverse of a given constituent found by analysis?—Yes.

6012. You are not thinking of a Court of Appeal on the question of analyses *per se*?—No, although that might very well be combined with it.

6013. Do you think of the Board as having any executive officers, or as relying entirely for its information on the public analyst or Medical Officer of Health?—I have not worked it out in detail, and I do not think I can give any very definite opinion upon that. In my own mind I had simply thought of the medical officer of health, but in practice it might come to be advisable for the Board to have officers of its own. Instead of beginning on a large scale, and working the thing out completely, I thought of beginning on a small scale, and seeing how it would work practically.

6014. Has the Gesundheitsrath a staff of inspectors?—I am afraid I cannot tell you that just now. I regret I have not looked up that point.

Sir
L. Branton.
26 Apr. 1901.

TWELFTH DAY.

WESTMINSTER PALACE HOTEL.

Saturday, 27th April, 1901.

PRESENT:

The Right Hon. LORD KELVIN (*Chairman*)

The Right Hon. Sir WILLIAM HART-DYKE.
Sir WILLIAM CHURCH.

Professor THORPE.

Dr. WHITELEGGE.
Mr. COSMO BONSOR.

Dr. BUCHANAN, *Secretary*.

Mr. RICHARD CHARLES GARTON, called; and Examined.

6015. (*Chairman.*) You are partner in the firm of Messrs. Garton, Hill and Co., Brewing Sugar Manufacturers, of Southampton Wharf, Battersea?—Yes.

6016. Is your produce solely used in brewing, or is it also sent out for use in various articles of confectionery?—Exclusively used in brewing.

6017. Not made for golden syrup?—No.

6018. You tell us that your firm was established in 1860; your father was the first to introduce invert sugar for use in brewing, and he worked out the process in conjunction with Dr. Lethely and Dr. Herapath?—Yes.

6019. Your firm manufactures a large percentage of the total brewing sugars made in this country?—Yes.

6020. What percentages?—Approximately 45 per cent. of that manufactured in this country.

6021. Shortly previous to the establishment of the factory by your father for the manufacture of invert sugar, had glucose been manufactured?—Yes, it had; not on a very large scale.

6022. For what purposes?—For brewing purposes.

6023. Not very much before your father took it up?—Only two or three years before.

6024. What do you mean exactly by "invert," which appears to be used in different senses?—I mean the product of the action of acid upon the cane sugar employed; the sugar is given a left-handed rotation to polarised light.

6025. Does any right-hand polarisation of the crystallisable sugar remain, or is it completely changed?—It completely turns over to the left.

6026. And the strength of the invert polarisation, is it equal to the strength of the direct polarisation of the cane sugar before the use of the acid?—The polarisation of the pure cane sugar would be upon a scale, as I understand it, plus 56; but when it is turned to the left it would give a minus 12 or 13.

6027. So that the invert rotation is much less than the original rotation in the opposite direction?—Yes; but may I be allowed to ask my head chemist, Dr. Thorne, who is here, if I am correct in the figure? I find that the change should be from the ratio plus 36 to minus 12½.

6028. Some ten years afterwards there was added to your manufacture of invert the manufacture of glucose for brewing?—Yes.

6029. You tell us that at a later stage your father became associated with Mr. Cornelius O'Sullivan, one of the pioneers of the practical work of the transformation of starch into sugars?—Yes.

6030. Had he patented processes for doing that?—He had.

6031. Patented details for the mode of application of the acid and the mode of their removal?—Yes.

6032. There was a special product, dextrin maltose, dextrin malt, the use of which arose from his work in conjunction with those.

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Mr. R. C. Garton. your father. How is that distinct from glucose?—It is a transformation product between starch and glucose.

27 Apr. 1901. 6033. It is a carbo-hydrate substance with properties intermediate between starch and glucose?—Yes.

6034. Glucose, invert and dextrin maltose are the only brewing sugars manufactured by your firm. They are all produced by the action of sulphuric acid either on cane sugar or starch?—Yes.

6035. Then various substances may be used for giving the starch?—Almost any starch-producing substance might be used for the manufacture of glucose.

Maize, sag, and tapioca flours made into glucose. 6036. Potato?—Potato might, but in our own case we confine ourselves to three products only, namely, prepared cornflour, sago flour, and tapioca flour.

6037. (Sir William Hart-Dyke.) Including maize?—Maize cornflour, but not raw maize. We do not use raw maize.

6038. (Sir William Church.) Nor rice?—Not in our own case. It is used in the manufacture of glucose, but not in our own specific case.

6039. (Chairman.) One of the cheapest forms of starch I suppose, is that derived from potato?—Not at the present day. It is not used in the manufacture of glucose in England at the present day. It is relatively dear as compared with other starches.

Rice and raw maize may be used. 6040. (Professor Thorpe.) I think it would conduce to clearness if you told the Commission, once and for all, what are the variety of starches used in the manufacture of glucose by all manufacturers, and what you yourselves specifically use?—I have given those which we specifically use. The other forms of starch would be rice and maize. Beyond that I do not think any other form is used.

6041. (Chairman.) Would you prefer tapioca to either rice or maize?—We ourselves do.

6042. Why?—There are certain oils and fats which are eliminated from rice and maize, which we consider to be detrimental in the manufacture of the brewing sugar.

6043. It would introduce an objectionable element, a disagreeable flavour?—Yes; it is a very disagreeable flavour at times.

6044. Would it be unwholesome in the beer?—I do not think the resulting product would be unwholesome, because of the subsequent process to remove anything of that character. But the starch of maize and tapioca flour and sago flour contains less nitrogenous matter, and is more easily worked than the other starches, hence we employ them.

6045. How is the sulphuric acid removed when it has done its work?—It is removed by the neutralisation of an alkali.

6046. What base do you use?—Chalk.

6047. No other?—We finish with a small percentage of lime.

6048. That has practically the same effect, lime and chalk?—Yes. No sulphuric acid is left in the solution in consequence.

6049. Do you find that the process of precipitation can be so complete as to leave no discoverable sulphuric acid?—I do consider so, and that is absolutely controlled by our laboratory department.

Amount of acid used in manufacture of invert, 6050. With respect to the manufacture of invert, do you use a definite proportion of acid?—The acids vary according to the class of sugar employed. We can use from so little as $\frac{1}{2}$ per cent. up to $\frac{1}{4}$ per cent. as the maximum. I have taken out an average which we consider to be used, and that is $1\frac{1}{2}$ per cent. of sulphuric acid.

6051. How is the percentage reckoned, by weight of sulphuric acid to weight of starch, or sugar as the case might be?—Yes.

6052. (Professor Thorpe.) Is that real sulphuric acid?—That is of the 70 per cent.

6053. (Chairman.) One and three-quarters of sulphuric acid of 70 per cent. strength to 100 by weight of sugar?—That is so.

6054. (Professor Thorpe.) One hundred by weight of raw sugar, which is not pure sugar?—Yes. It would contain some invert sugar, and some moisture, and a little ash, and some alkaline salts.

6055. What would be the average of real sugar in what you are using?—About 90 or 92 per cent.

6056. (Chairman.) Ninety per cent. of crystallisable sugar?—No. of total sugar.

Mr. R. C. Garton. 6057. That includes crystallisable sugar and un-crystallisable, including molasses?—Yes.

6058. There would be a considerable proportion of crystallisable sugar, and a considerable proportion of grape sugar?—Not a considerable proportion of the latter, not exceeding 8 or 9 per cent.

6059. With regard to the manufacture of glucose?—and in m The percentage of acids will vary to a greater degree, almost, than in the process of making invert sugar. It would go from $\frac{1}{4}$ per cent. in the case of American cornflour, which I described just now, up to 8 per cent. for some of the tapioca flour. It varies from $\frac{1}{4}$ to 8 per cent., but I see that the average taken from our books is $5\frac{1}{2}$ per cent.

6060. (Professor Thorpe.) Of the 70 per cent. acid?—Yes.

6061. (Chairman.) How do you explain that more acid is wanted for one of the substances and less for another?—Because there is contained in these starches a large percentage of fibrous matter to which the acid goes instead of carrying on its direct conversion.

6062. Is that fibrous matter nitrogenous fibrine?—Yes.

6063. Do you use pressure in the manufacture of glucose?—That is so.

6064. Without the pressure you would need a still larger quantity of acid?—Yes, a larger quantity of acid would be employed without the use of pressure.

6065. (Sir William Church.) You speak of prepared cornflour; is that other than ground?—It is a precipitated starch after being washed and dried.

Object for rev 6066. (Professor Thorpe.) I think perhaps it would conduce to clearness if we had it upon the notes why treatment by sulphuric acid is required in these things as a process to begin with. Take the case of cane sugar. Cane sugar is a sugar fermentable by the action of yeast. When you add yeast to cane sugar, would you tell the Commission exactly what happens?—The first action would be that the yeast would act upon the cane sugar and invert it, but the process is an exceedingly slow one, and a very difficult one to carry out because of the manner in which it weakens the yeast plant. The object of inverting sugar by acid is to bring it readily into that state. In brewing when you add your inverted cane sugar the yeast is immediately able to go about its work, and is not weakened or deteriorated by having to do inversion first.

6067. When you act directly on cane sugar by means of yeast it requires a considerable amount of time before the true alcoholic fermentation is started?—That is so, and there is considerable danger that the alcoholic fermentation might not catch on in time to prevent the other bodies being formed.

6068. What you do by this hydrolizing or inverting by means of sulphuric acid is that you quicken the action you would otherwise have to do with the yeast?—Putting it in my own words, we assist the yeast to take on the vinous fermentation at once.

6069. You use the word "carbo-hydrate"; would you kindly explain what you mean by the word carbo-hydrate?—Perhaps I might ask Dr. Thorne to deal with this. It is more of a chemical term.

(Dr. Thorne) (Chemist to Messrs. Garton, Hill, and Co.) The carbo-hydrates are those series of compounds in which the composition of the substance is in the proportion of the carbon and water.

6070. All sugars are carbo-hydrates?

(Dr. Thorne.) Yes.

6071. But all carbo-hydrates are not sugars?

(Dr. Thorne.) No; carbo-hydrates would include all the starches.

6072. The word carbo-hydrate is a generic term including starches, sugars, and all substances in which the ratio of the carbon to the water is as you have stated. (To the Witness.) Some of these carbo-hydrates are fermentable and some are not?—That is so. Some of the sugars in those carbo-hydrates are fermentable and some are not.

6073. In the action of sulphuric acid upon the materials that you employ for the manufacture of glucose, the various starches with associated cellulose or similar matter, cellulose itself being a carbo-hydrate, does that cellulose itself contribute in any way to the formation of sugars?—Yes, it does. The cellulose is

Mr. Garton. converted into a form of sugar by the action of the acid.

pt. 1901. 6074. A fermentable form of sugar?—No.

6075. Then you really get more sugar in your glucose than corresponds to the amount of starch present with which you started?—That is if you have a lot of cellulose.

6076. In maize, where you would have a large amount of associated cellulose, do you get more glucose than corresponds to the amount of starch present?—I am not able to answer the question with maize because I have not worked upon it.

6077. Take the case of second grade tapioca and sago, where the mixed foreign matter other than starch is considerable?—It is minute.

6078. But you would have a certain amount of sugar other than from the pure starch?—It would be a very small percentage indeed.

6079. What do you mean by a very small percentage?—At the most it would be half per cent.

(Dr. Thorne.) Practically none of the cellulose is converted in the ordinary way of working; at most 1 or two per cent. of the cellulose present is actually converted.

6080. What do you mean by the ordinary way of working?

(Dr. Thorne.) The commercial way of working.

6081. But of course it is theoretically convertible?

(Dr. Thorne.) But it requires longer treatment and higher pressure.

(Witness.) In the face of that subject we are quite aware of the fact that these non-fermentable bodies could be formed if the starch was left too long in contact with the acid, and that is one of the things we have to guard against to prevent these bodies being formed by the destruction of the sugar which would be formed by the conversion by the remaining acid.

acture
ose. 6082. (Chairman.) The acid you reckon at 70 per cent. with a specific gravity of 1.6. Do you dilute it before applying it to the starch?—Yes, it is diluted to a specific gravity of 1.200.

6083. You spoke of pressure being used; what pressure do you go to?—30 lbs. pressure. The vessels are made of gunmetal.

6084. And the liquor raised to boiling point at that pressure?—The action of raising the pressure brings it up; the vessel contains steam coils.

6085. What temperature is the liquor raised to in the vessel?—275° Fahrenheit.

6086. Does so high a temperature tend to alter the fermentability of the product?—We use our acid accordingly, and the time of the operation is a big factor in that connection. As a result of the conversion I think I may say that glucose in the ordinary form contains very little matter which has been transformed from sugar into a non-fermentable carbo-hydrate.

6087. Do you use pressure in the manufacture of invert as well as of glucose?—We never put cane sugar or sugar used in the manufacture of invert into a pressure vessel.

6088. If you were to apply to cane sugar the same pressure and temperature as in the case of glucose, would not that convert some of the sugar without acid?—We should caramelise the sugar.

6089. But as a fact it would be inverted?—Yes; but there would be also destruction.

6090. Would not that be fermentable?—No.

6091. Have you studied the optic property of caramel?—I have not, personally.

6092. It is inverted, is it not?

(Dr. Thorne.) Up to a certain extent; but the action is carried much further, it does not stop at invert sugar. When you get caramelisation taking place you get a large number of other carbo-hydrates, some of which are fermentable and some are not, and the caramel is not one product, but a mixture of decomposition products.

6093. (Professor Thorpe.) The process of caramelisation is attended with the abstraction of water?—Yes.

6094. (Dr. Whitelegge.) You told us that you manufactured glucose for brewers only: that meant brewers are your only customers?—They are.

6095. There is a considerable amount of glucose used

in other manufactures than brewing, is there not?—There is.

6096. That comes from the other manufacturers in England, and from foreign sources?—I think no other manufacturer in England sells other than for brewing purposes.

6097. Can you say why—is the substance required different?—I cannot explain why because I could manufacture it myself for confectionery purposes, but we do not.

6098. What you would manufacture for confectionery purposes would be different in some respects from the article you make now?—The article used for confectionery purposes is that which I have described here as dextrin maltose, that is the composition of the article which is now used in the country for confectionery purposes.

6099. Do you make dextrin maltose?—Yes, for brewers, but not for confectionery.

6100. The dextrin maltose required for confectionery is different from the brewing dextrin maltose?—No.

6101. Is the dextrin maltose you manufacture suitable for confectionery?—Yes, it could be used, so far as dextrin maltose is suitable for confectioners.

6102. It is a mere accident that all you make goes to brewers?—Clearly; we could manufacture it for the confectionery market if it were deemed necessary.

6103. But I understand you to mean there is more than that, that the article you manufacture is suitable for confectioners if confectioners come to you to buy it?—Yes; so far as it is suitable for confectionery purposes; it is almost the identical substance; it is an intermission product after the conversion of starch by acid.

6104. Confectioners use other forms of artificial sugar, do not they, besides this?—I am not quite sure on the point.

6105. Do you supply cider makers or mineral water makers?—None.

6106. Can you tell us whether they use a sugar similar to what you prepare?—I do not think they do.

6107. Potato starch is used to make glucose abroad I understand you to say?—Yes.

6108. Not in England?—On account of its price only.

6109. Would the product be different at all in appearance or properties?—No, I do not think it would be. There is a distinctive property in glucose manufactured from potato starch, and that is that it has rather a bitter flavour.

6110. (Chairman.) Do you sell dextrin maltose as a separate product different from the brewing sugars?—Yes, by name of dextrin maltose. The invert cane sugar is sold under the name of laevo saccharum. The glucose is sold by us as dextro saccharum as denoting the two forms of sugar.

6111. What kind of sulphuric acid do you use, brimstone acid is it?—We originally used brimstone acid made from Sicilian brimstone.

6112. Did you give up the use of brimstone acid?—Yes, some years ago; the object was this, that the people from whom we bought our brimstone acid represented to us that by the process of purifying sulphuric acid we could get it as pure and as free from arsenic as the brimstone acid, and we satisfied ourselves upon that point, and after considerable research by our head chemist, at that time Mr. Heron, we adopted the use of the de-arsenicated pyrites-made acid.

6113. Arsenic was the special substance to be removed by purification?—Yes, we have been well aware of the presence of arsenic in acid ever since we have been in business.

6114. In the purification of pyrites acid is there anything but arsenic to be taken out of it?—There is iron and lead and the nitrous compounds.

6115. Does lead get into the pyrites acid?—Yes.

6116. Iron comes from where?—The iron would be in the pyrites.

6117. (Professor Thorpe.) The iron would be everywhere, in the coke and the towers?—Yes; I am only able to describe the particular points that we wished to avoid in our acid. I am not conversant with the actual manufacture of the acid.

6118. (Chairman.) Iron is one of the substances to be got rid of. How does it get into the acid?

Mr.
R. C. Garton.
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English glucose makers supply brewers principally.

Potato starch expensive.

Uses de-arsenicated pyrites acid.

Mr. R. C. Garton. (Dr. Thorne.) I think it would come mainly from the coke in the Glover towers, and so on, that the acid ran over; not in the fumes, but only after the sulphur had been turned into liquid acid by the steam and moisture.

6119. (Chairman.) For the last twenty years you have always obtained your sulphuric acid from one source?

(Witness.) Yes; Messrs. F. W. Berk and Co. We have always dealt with them.

6120. Do they supply brimstone acid, or have they given up the making of it?—They have given up the manufacture of brimstone acid.

6121. (Mr. Cosmoonsor.) Has the price varied much for your acid?—The price has never varied at all. We have never discussed the price with them. We pay them a good price, and we have never gone into that question since.

Supply in special tank. 6122. (Chairman.) You take care that you get the acid not contaminated on the way to your works?—We are very cautious in regard to that, because we will only allow it to be supplied in one barge kept for us alone. It is not supplied in carboys. It is supplied in a tank barge.

6123. A tank of what material?—A lead tank.

6124. (Sir William Hart-Dyke.) Belonging to the vendor?—Yes.

6125. (Chairman.) A small quantity of lead may be taken up from the tank?—Not at the gravity at which we receive it.

6126. Do you receive it at the gravity of 1·6?—Yes; our own chemist takes charge of the acid as soon as it arrives at the works. No portion of the cargo is allowed to be discharged until our own head chemist has certified he is satisfied.

6127. (Dr. Whitelegge.) How long has that system been in force?—It may be 15 years; I cannot be quite sure.

No written contract with sulphuric acid maker. 6128. (Chairman.) Have you a written contract with Messrs. Berk?—No; we have never had a written contract with them. Everything is settled verbally. It is an old, long-standing arrangement which is continually renewed and discussed from time to time as we see them.

6129. There is no chance of their forgetting that there must not be arsenic in it?—We have their definite assurance that they examine every load before it leaves their place.

6130. (Sir William Church.) Messrs. Berk and Co.'s works are on the river, are they not?—Yes, at Bow.

6131. This arrangement could not probably hold good in another factory?—No. Other manufacturers do receive it in carboys, but ours is a very special way of receiving it, and makes it exceedingly easy to detect whether the acid is right or not.

6132. (Sir William Hart-Dyke.) And you can test a large quantity at once?—Yes; a large bulk.

6133. (Chairman.) You have perfect confidence in Messrs. Berk and Co., but you think it right to keep a check of the supply?—That is in accordance with our method of working; we check everything we take into the works. I do not mean any particular reference to arsenic, but everything is taken into the laboratory as it comes into the works in the ordinary way of business.

6134. You require colourless acid?—We have always colourless acid.

6135. Do you have any B.O.V.?—No; this acid is the colour of water. I have brought a sample, if you would like to see it. (Sample exhibited.)

6136. Do you know if brown oil of vitriol is used by any glucose manufacturers?—No, it is not.

6137. You consider the colourlessness of the liquid important as security against accidents?—Yes.

At a constant price. 6138. Do you get this at a constant price?—The price has never varied. I think acid can be bought cheaper than we buy it, but we have been satisfied to pay this price, feeling that we were in good hands, and that it would be unwise to discuss any question of economy.

6139. What is the price?—42s. a ton.

6140. For delivery in large lots?—We receive it in tank barges holding about 30 tons.

6141. You have invoices in support of this statement?—Certainly.

6142. (Professor Thorpe.) If Messrs. Bostocks were paying 47s. 6d. for the same character of vitriol, they

were also paying a very good price too?—That included the carriage of carboys from Leeds to Liverpool. The carriage I expect would be a substantial item. Our carriage is a very minimum sum, because it is simply a tank journey from wharf to wharf.

6143. (Mr. Cosmoonsor.) Who does the tank barge belong to?—Messrs. Berk.

6144. Does the price charged by Messrs. Berk vary with the market?—No; the price has been very nearly constant. I think perhaps in that we might have opened up a question, but we have always considered it was best to leave the price as it stood.

6145. Carriage to a distance would involve its being put into carboys?—It would.

6146. Would that be a source of danger?—I think it might be some source of danger that carboys might be mixed.

6147. But not with proper precaution?—No, none whatever.

6148. It would add largely to the cost?—Very largely indeed.

6149. (Professor Thorpe.) You are aware there are other methods of transmitting oil of vitriol than in carboys, even long distances?—No; I have not gone into that.

6150. You can send it in large cast-iron cylinders. It is sent by railway constantly?—Naturally it could be done, in the same way as we have ours in a tank. It is merely a tank on wheels.

6151. (Chairman.) Have you ever examined the sugar with a view to detecting impurities, if there are any?—Not before this occurrence of the outbreak in Manchester.

6152. But in this outbreak?—We have analysed a large number of samples.

6152*. Have you found any arsenic in any of them?—It is extraordinary, seeing how very largely diffused arsenic is that the samples should be so free. I should not like to say that we have not found any arsenic, because the test is so extraordinary that you can find the minutest possible trace. I have here tubes, if the Commission would like to see them, of various quantities of arsenic that we have detected both in our acid and in other materials, but it is of such an infinitesimal and minute character that it almost might be called negligible. (The tubes were submitted to the Commission.)

6153. Is this from the sugars or some of the ingredients?—That is from the glucose, a glucose which we have made and tested by the Marsh test. The tube will show you how exceedingly free the sample was from arsenic under the severe test.

6154. Have you tested some of the raw materials?—Yes; but we find no arsenic in those. This is another tube, a glucose, which was made in the very early part of November, and represents a sample which was out at the time of the outbreak in the trade. There you see an infinitesimal spot. We have tried large numbers, and we find no trace, but I bring this one forward as showing what could be found. I think that contains about 1,000th part of a grain.

6155. In what quantity of glucose?—In a pound of glucose.

6156. That is a specimen manufactured on the 10th of November, 1900?—Yes. In connection with that it would be interesting to see the standards. (The standards were shown to the Commission.)

6157. How do you account for the minute quantity of arsenic in that specimen?—It might come from so many trivial causes. It might come from a tank, it might come from a little new charcoal over which it was put. Of course, we should never have found that amount under the old method of testing. That is the result of a test extending over nearly half an hour in the Marsh test. At 10 minutes that did not show any reaction at all for arsenic. I brought it up to show to the Commission how very minute it was, and the very small quantity that could be found. Here is a sample of the pyrites acid. (Sample put in.)

6158. This is the 23/3/1901, that is the 23rd March?—Yes. Here is a sample of the brimstone acid. (Sample shown.)

6159. This is the 26th April?—Yes. That was a sample of brimstone acid we had from the people who manufacture our pyrites acid. We have been going into the question of brimstone acid with them. They do

Mr. C. Garton. not make it, but we have been discussing with them as to whether we should buy brimstone acid in the future, and that is a sample we had to see how it looked.

Apr. 1901. 6160. Of Sicilian brimstone acid?—Yes.

(Dr. Thorne.) That was not their manufacture, it is only a sample they obtained for us, not their own make.

(Witness.) But they are putting themselves into a position to make brimstone acid.

6161. (Chairman.) They got this from a brimstone acid manufacturer?—Yes.

6162. (Professor Thorpe.) Was that sold to you as free from arsenic?—That is not sold to us, it is only a sample sent to us to examine.

6163. But not put forward as free from arsenic?—I anticipate by its being sent in that form that it was. Here is a sample of another delivery of our acid. That is a pyrites acid.

6164. But there is something here?—Yes, that is the result where 20 grammes of the acid has been taken and kept in the Marsh test for half an hour, and that is the only result we could get.

6165. What do you consider the colour here proves?—It may be a trace.

6166. Might it be something else?—It might be anything. It is so infinitesimal that it is impossible to say. (The standards were explained by Dr. Thorne to the Commission.)

6167. (Professor Thorpe.) On the test which you have shown us, it would be obviously a greater security to insist upon de-arsenication in the acid, whatever it be, than to take it on the assumption that it was pure because it was made from Sicilian sulphur?—That would not do at all. The proper course would be to have a guarantee that the acid was de-arsenicated, apart from what it was made from. It would be a sense of false security to think that because you bought sulphur-made acid you would therefore have arsenic-free acid. With a guarantee of de-arsenicated acid you would be perfectly safe.

6168. (Chairman.) Do you know the process that Berk and Co. follow in making the acid? Is it the same as other pyrites acid makers?—Yes, they purify the acid for our purpose by a special process.

(Dr. Thorne.) By the sulphuretted hydrogen process.

6169. (Chairman.) Do you know how much difference that makes in the cost?—I think it is absolutely nominal.

6170. Do they sell acid not so purified to those who do not demand purity?—Yes. This is a sample of their brown oil of vitriol. (Sample shown.) It has not been purified. We asked them for this sample, which we thought might be interesting. It is not de-arsenicated.

6171. The price of this is not greatly less than the price of purified acid?—The difference is very nominal indeed.

6172. Do you know what the price of this is in the market?—I cannot give it to you definitely.

6173. (Sir William Church.) Have you had your acid tested for anything else besides arsenic?—Yes, from time to time.

6174. Has any special investigation of it been made for selenium?—Yes, our chemist has tested it for selenium.

6175. Has any trace of selenium been found?—Not in the pyrites acid.

6176. In the brimstone acid?—I think he has come to the conclusion that infinitesimal traces have been discovered.

(Dr. Thorne.) Yes. I have not come across a brimstone acid absolutely free from selenium, but I have not detected it in purified de-arsenicated pyrites acid. The process of purification takes out the selenium at the same time it takes out the arsenic.

(Sir William Church.) As far as any danger from selenium comes, there appears to be less in pyrites than in brimstone acid.

(Dr. Thorne.) I should say emphatically less.

6177. (Mr. Cosmo Bonsor.) The test for selenium is a very easy one, is it not?

(Dr. Thorne.) In large quantities, not in a very fine degree.

6178. (Mr. Cosmo Bonsor.) Anything that would be likely to be injurious to health would show itself very quickly?

(Dr. Thorne.) You can test easily to one part in 200,000. I say that because the arsenic test goes to one part in seven millions.

6179. (Chairman.) Would selenium show in the colour of the deposits we have in some of those tubes?

(Dr. Thorne.) Yes, but precautions have been taken in all those tests to remove the selenium in the process.

6180. Have you found selenium can be removed?

(Dr. Thorne.) It can be removed.

6181. You found there was selenium, which had to be removed?

(Dr. Thorne.) In brimstone acid I found selenium present. In pyrites acid I found no selenium present.

6182. (Professor Thorpe.) What you mean is that you so arranged your method of testing for arsenic that it would have eliminated any selenium which had been there?—(Dr. Thorne.) Yes. In those tubes it is arsenic, and there is not a chance of there being selenium. Selenium has been tested for separately, but not in that test.

6183. (Chairman.) (To the Witness.) Would it make any difference to you if there was a statutory guarantee of purity imposed?—The purity of the article we manufacture?

6184. Either of the article you manufacture or of the sulphuric acid that you admit?—It would not make the slightest difference, because we have always acted on that necessary guarantee to the public.

6185. You have gone on without a written guarantee, but by care on your own part and the part of the makers you find it satisfactory?—Absolutely satisfactory.

6186. Then it would not disturb you if there was a satisfactory guarantee of purity to be given by the acid makers?—It would not make the slightest difference to us in our manufacture, or any other way. We should be quite prepared to carry out any recommendation that the Commission might think fit to make.

6187. Since the outbreak your firm have, in fact, adopted a form of guarantee for purity?—Yes. Immediately upon the outbreak we issued a guarantee, the form of which I have brought, and which is now in use.

6188. "We certify that the delivery to which the enclosed invoice relates is perfectly free from arsenic or other deleterious ingredients"?—That is the notice.

6189. (Professor Thorpe.) Who signs that guarantee?—One of the partners, every day.

6190. Does the chemist take part in the guarantee?—We receive his report before the guarantees are signed. He sends down his report to the partners on his samples, and we sign the guarantees then and there.

6191. Would there be any difficulty in making him jointly responsible for the guarantee?—Not the slightest difficulty in the world. He is practically now responsible, because we should not sign the guarantee without we had his authority to do it.

6192. But it would be desirable for statutory purposes that the name of the tester should go on the guarantee form?—That would not make the slightest difference to us; it could be very readily carried out.

6193. (Dr. Whitelegge.) Messrs. Berk and Co. are chemical manufacturers in general?—Yes.

6194. They make other things than sulphuric acid?—Not at these works.

6195. Do they make sulphuric acid for other purposes?—Yes, for manure purposes.

6196. And largely for those other purposes?—I am not able to say the extent of their manufacture. Their chief works, I think, for other chemical manufactures are at Swansea.

6197. But at the same works at which the sulphuric acid for your purposes are made, other sulphuric acid is made?—I believe it is.

6198. (Chairman.) You have made no change in your mode of action in respect of the supply of acid since this scare?—We have made no change in our methods at all. It was considered the proper course to pursue to go on just as we have been working.

6199. (Dr. Whitelegge.) Is there not rather a difference implied in your statement, that since the outbreak every material has been specifically tested for arsenic?—That is the only difference. The method has always been that a sample of the acid is taken directly the barge arrives. It is placed in the laboratory. That

Mr. R. C. Garton.
27 Apr. 1901.

Guarantee of purity of sulphuric acid or of manufactured article advisable.

Form of guarantee now issued with these products.

use of arsenic acid-sulphuric (slight).

stone may contain arsenic pyrites will not.

Greater stringency in testing acid for arsenic recently.

Mr. R. C. Garton. has been always the case. Now the only alteration is that we test each of those samples specifically for arsenic.

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6200. That was not done before the outbreak?—Not every sample, but they were constantly being tested.

6201. Constantly being tested for arsenic?—Yes. In fact, it had been tested at quite a recent period before the scare. That was not done because we feared that the manufacturer was selling us an inferior article, but merely in our common way of business as a check.

6202. (Professor Thorpe.) Of course, this certificate that you give necessarily has reference to a particular method of testing?—Yes.

6203. And also to a particular amount of material which is used in the testing?—Yes.

Official standard for arsenic should be prescribed.

6204. Therefore it only indicates a particular standard of delicacy?—As applied to ourselves, yes. In that respect it would be most desirable that some common form of working should be adopted.

6205. What would you suggest as to how that common form of certificate should be arrived at so that all certificates might have equal value? Have you any suggestions to offer to the Commission as to how that could be attained?—Seeing that analytical chemists from all parts are constantly testing these samples, to my mind the best way would be to arrive at a common understanding by some conference.

6206. A conference arranged between whom?—Between those chemists and the officials.

6207. What officials?—The Government officials.

6208. (Mr. Cosmo Benson.) You would be quite satisfied if a Government Department was the reference?—Absolutely satisfied.

6209. (Professor Thorpe.) Are you speaking of brewers' materials or of things in general which may contain arsenic?—I am speaking of brewing materials.

might be done by Ireland Revenue in the case of brewing materials.

6210. Would it satisfy you, for example, as a manufacturer of brewing sugars, if the Excise authorities were to take charge of a small departmental committee to fix the methods and generally prescribe the form of certificate under which all manufacturers of brewing sugar should work?—I think it would be most admirable. It would get rid of a great deal of trouble and the harassing that is now going on. In fact, I consider that it is absolutely necessary that some common form of guarantee should be arrived at.

6211. I may point out to you, of course, that the matter is rather far-reaching, because it does not merely concern the Excise authorities immediately, but it concerns, of course, public analysts who are not under the Excise remotely?—Yes.

with aid of Committee of chemists.

6212. Therefore you must have a rather wider organization to take the whole thing into consideration?—That is why I made the proposition that the general body of chemists should be consulted as to the method to be adopted.

6213. That is rather a large order, is it not?—I think you could get representatives from the chemical societies.

6214. You mean that you would like to see a committee formed in which all the interests, say the Excise authorities, yourselves as manufacturers?—I think you might eliminate us from the conference.

6215. Would not the maltsters, for example, be concerned?—I think not. I think they would be perfectly satisfied if a common form was adopted.

6216. Then your idea is that a committee of chemists and persons concerned with the testing of brewing materials and also of the testing of finished beer as the public takes it, should draw up regulations with a view to determining methods for standards of purity?—I do think so.

6217. Supposing a committee had come to some arrangement defining the methods, and, therefore, conducting the degree of delicacy, what could they do further; to whom would they report; what further action is contemplated?—I do not quite understand.

6218. This Commission, for example, might appoint a small sub-committee or recommend the formation of a small sub-committee to take up that particular aspect of the question. They might make certain findings. What would be the subsequent action? How would they become operative?—You mean to say how would they be received.

6219. Who would deal with them?—Which department of the Government?

6220. Yes?—I suppose the laboratories are not to be thought of. I do not know that I can make a suggestion.

6221. (Mr. Cosmo Benson.) You are aware of the two Acts of Parliament, the Sale of Food and Drugs Act, which looks after the adulteration of food generally, and also the regulations as regards the prevention of deleterious articles entering into beer which is looked after by the Excise. Either of these departments would do, would not they?—Yes, either would do, but I am quite unable to say which would be the better.

6222. (Chairman.) You have no experience of their action; you have not been attacked for adulterations nor for deleterious impurities by persons acting under instructions of either department of the Government?—No.

6223. You have no experience of such action, and cannot offer us any advice?—No, I cannot.

6224. But you are willing to accept anything that is proposed?—Yes.

6225. (Dr. Whitelegge.) Would you be equally content with administration in that sense by any local authority?—Do you suggest a County Council authority?

6226. Yes, by the county authorities or other local bodies?—I should prefer the other method.

6227. (Chairman.) Have you ever used any other than the Marsh test for arsenic?—No, we have always used the Marsh test.

6228. Have you ever used Bloxham's electrolytic test?—No.

6229. I do not know whether you or your chemist have thought of the electrolytic method?—(Dr. Thorne.) I have been intending to experiment with the electrolytic method, but really, my time has been so much taken up with this matter, and I have been so satisfied with the character of the result of the Marsh test and the delicacy and absolute certainty of the Marsh test, that for the present I have stuck to the Marsh test. I think that the Bloxham test might possibly be a very satisfactory one, but I do not think it can exceed the satisfactory character of the Marsh test.

6230. (Chairman.) Might Bloxham's method possibly give more definite quantitative results?

(Dr. Thorne.) I do not think so.

6231. (Sir William Church.) Your firm seems always from the commencement to have from time to time tested your sulphuric acid for arsenic?—Yes.

6232. As a practical manufacturer of what is really a foodstuff do you not think it is the duty of every manufacturer of foodstuffs similar to this, to take the same precaution, and from time to time test for themselves the purity of any substance like sulphuric acid of which everybody knew might be contaminated?—I think as a check upon his business he ought to do so, but the great responsibility would lie with the manufacturer who makes the acid for him in the common understanding that they work together.

6233. You would say without doubt that where there is no specific contract that de-arsenicated acid is used it is the duty of the manufacturer of invert or glucose to see that the acid he uses is pure?—Yes, by a check.

6234. (Dr. Whitelegge.) If by accident arsenic found its way into sugar manufactured by you you would find it by your own tests?—Yes.

6235. Would you be able, by looking back at the record of your tests, to say whether there had been arsenic in a particular consignment?—Do you mean with regard to tests that we have made?

6236. Yes?—We have got samples of our various sugars ranging over a considerable period.

6237. Have you a record of the tests being made and the result of the tests?—For arsenic pure and simple, records no; although we make our tests for arsenic and keep our laboratory book, if the things are right there is scarcely any record made. When there is anything which comes under our observation which ought to be put into our books we place it there.

6238. Your record is only a record of something being wrong?—Yes, in that sense.

6239. Is that so well established a practice that if there is no record you may assume with confidence it is right?—In our case distinctly.

Mr. R. C. Garton. 17 Apr.

Duty of sugar manufacturer to check purity of his acid.

Mr. Garton. 6240. If arsenic was found in a sample of sugar you could trace that back to a particular consignment of sulphuric acid, and if there was no record of the sulphuric acid containing arsenic then you would know that certainly there was no arsenic there?—Dependent on the fact whether the arsenic was produced by the acid.

6241. I do not mean that you trace the arsenic back to sulphuric acid, but you trace back the sulphuric acid which took part in that sugar?—Yes.

6242. You would know the sulphuric acid was free if there was no record?—Yes, and it was not answerable for any trace of arsenic that might be found.

6243. (Chairman.) Do you record in your books that tests have been made even when the results are blank?—We have never made those records.

6244. You do not say, so many tests were made and nothing found deleterious?—No; I have in my laboratory book a record that every barge of acid has been sampled and recorded.

6245. That it has been sampled and tested?—Tested in some form or other. It is placed in the laboratory for the chemist; that has been the practice for many years.

6246. So that there is no chance of an inadvertence in respect to things passing?—The acid could not be possibly taken into the works except it was passed by the chemist.

6247. (Sir William Church.) I understand you to say that although in the general course of your business you did not test every tank barge for arsenic you have been in the habit from time to time of doing so?—Constantly.

6248. And you think that that precaution should be used by all manufacturers of brewing materials, glucose and invert?—Yes; coupled with the understanding that the article is being made for the particular purpose.

6249. Still more so if it is not coupled with that understanding?—Yes.

stage of 6250. (Chairman.) With regard to the use of sugars in in brewing what do you say?—They are in no sense og adulterants or substitutes for better material. One or other of them is used by all of the best brewers in the Kingdom often without any economy, and solely for improvement of quality, and in other cases because you can obtain an equal or superior quality at less cost and trouble. So far from these products belonging to the type of adulteration, they represent the real growth of the science of brewing, and the excellence of the products go hand in hand with the increase of skill in using them. Glucose and dextrin maltose are derived from pure starch just as much as the maltose which is formed in the mash tun and by an equally pure process. They are sugars of the same type as the maltose, and in every sense as suitable for the purpose. But they have the great advantage that they can be made free from those types of nitrogenous matter found in barley malt, which constitute one of the greatest difficulties in brewing English beer, their removal necessitating prolonged storage of the beer and the employment of much hop. It thus puts a definite material in the hands of the scientific brewer by which he can obtain complete control over the article produced. With regard to invert sugar, it is a far more expensive article for the brewer than the cane sugar itself, and the whole manufacture is for the purpose of giving him a more readily fermentable sugar than cane sugar, which cannot be employed without materially weakening the yeast. So important are these properties that all modern ale requires their use. As compared with malt, there is no economy in the use of invert, as a pound of extract obtained from invert is about the same cost as that obtained from malt, and yet three-quarters of the total production of my firm consists of this substance. It is for the results of the brewing, and not for lessening the cost of the materials, that it is employed.

6251. (Sir William Hart-Dyke.) I suppose you could tell the Commission whether the occurrence of this great scare has made any practical difference in the trade?—On the contrary. It has not diminished the use of sugar, but in the particular district where the outbreak took place it has largely increased it.

6252. With regard to your own trade. I do not want to ask you anything inquisitorial, but generally speaking, as regards your own trade, have you found any alteration in it since this scare occurred?—No diminution.

6253. You referred to the use of these materials, glucose and invert sugar, as being used for brewers for improvement of quality, and you make some comparison between their use and that of malt later on, where you state that there were certain difficulties with regard to brewing with malt which are got over by this quicker process. With regard to malt: is it not a fact that in the English barley growing districts in bad seasons, when the barley grown is not of very good quality, sugar has been very largely used?—Yes; that is to enable the brewer to use that quality of barley.

6254. That is to say to supply the saccharine matter which is absent in the barley?—Yes.

6255. In a season where a very good sample of barley is grown in this country there is naturally more of the barley used for malting purposes minus this addition which is otherwise necessary?—The sugar is not so necessary when a good quality of barley can be produced.

6256. You are aware that in debates in the House of Commons on this question of malting and the use of substitutes, it has been said by leading brewers in the House of Commons that if they were forced to use nothing but barley they would have to go to the foreigner so as to get the very best article when a good sample is not grown in this country?—Yes. I confirm that absolutely as a brewer. I consider that unless a true sense of the position is quickly ascertained, one of the most serious blows to the farmer is now about to take place. This recent agitation on behalf of the pure beer movement, resuscitated because of the arsenic scare, has carried the whole history of the use of these brewing materials into a new phase, and if this Pure Beer Bill were passed, I have no hesitation whatever in saying that the British barley grower is practically doomed. I will give you a specific instance which will emphasise all I have said. In anticipation of what is going to happen in connection with this Bill, a brewing friend of mine in the North, who has never used foreign barley at all, has this week purchased 10,000 quarters, which he is going to use in the place of English barley. That has only to be accentuated throughout the country, and I think the last stage of the British farmer will be very much worse than the first.

6257. Are you an agriculturist yourself?—In a small way.

6258. I suppose so long as your trade lives and thrives you would be rather in favour of the use of malt, generally speaking, for beer?—I am taking it from a scientific point of view, and also from the point of view that I am a brewer in a very considerable way.

6259. You urge that one of the difficulties with regard to the malt brewing is the prolonged storage that is necessary?—True.

6260. Surely you are aware that beer brewed from malt and hops is a very popular beverage in this country?—I am not inclined to accept that theory. I think a good deal of political agitation has been raised on the subject, but I have my doubts as to whether it is the popular beverage.

6261. You have your doubts?—Very strongly.

6262. You would not urge that the necessity of storage was a great difficulty in the use of malt and hops?—I think you cannot produce even with lengthened storage the quality of beer which the ordinary public require to-day; malt and hops alone would not produce it; you would have to re-educate the consumer to malt and hop beer.

6263. You think that when once the consumer is initiated in what you consider the merits of beer brewed under the system you advocate, he would not go back again to the other?—It will take a very long time to get him back to the old malt and hops.

6264. You are aware that evidence has again and again been given before this Commission that by common care in malting, beer brewed from malt can be made absolutely secure?—That is the fault I have to find with the manufacturer who brought about this trouble—that even with common care his sugar need not have contained any arsenic.

6265. In either case, as regards the consumer, you wish to urge upon the Commission that it is really a question of common care whether brewing from malt or brewing from glucose?—Yes; the whole question of arsenic in these materials is quite new to us all.

6266. (Chairman.) Is there not an economy in the use of invert, to save the cost of malt?—There is no economy in the use of invert sugar.

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Mr. R. C. Garton. 6267. Why should it be used?—Because it produces a better result than all malt alone.

6268. So that you consider that the buyer would be inclined rather to take beer not certified to be malt and hops alone?—I think he would if he were left alone.

6269. (Sir William Church.) To put it another way—you say that both, looked at from the scientific aspect and also from the practical aspect as a brewer, that a better quality of beer can be produced by a certain quantity of invert sugar and glucose being used than without it?—Emphatically.

6270. Do you think that if a large percentage of glucose or invert sugar is added it might impart any unwholesome property to the beer?—No, it would not. I say this distinctly, that if you use too large a percentage you do not get a beer, you get that which is more inclined to be a wine.

6271. Do you think it makes any difference in the wholesomeness of the finished beer whether you use a large proportion of glucose or invert sugar before the fermentation of the beer, or whether you add it afterwards?—I do not think it makes any difference, because the sugar in itself is perfectly pure and wholesome; in one case it is split up into the carbonic acid gas and the alcohol, and in the other case it may be that some of the sugar remains in the beer unsplit up, which the fermentation continues to split up as it goes along.

6272. May we take it as your opinion that it is not for lessening the cost of materials that brewing sugars are employed?—It is not.

6273. (Sir William Hart-Dyke.) I suppose that what I may call the more modern process of brewing without storage, although the materials are more expensive, yet the beer is brewed in one month and drunk the next month. Given the demand for it, the brewers would not lose much as against the old storage method?—There is an economy, I grant, in the fact that you can get your beer into condition earlier, but there is no economy in the first cost of the material.

6274. (Mr. Cosmo Bonsor.) You mentioned a friend

of yours in the North who bought 10,000 quarters of foreign barley. Was that since the Budget statement of the Chancellor of the Exchequer?—It was this week.

6275. Possibly it may have something to do with using the foreign malt to replace glucose and invert sugar?—I have it from his own mouth that it was in anticipation of the fact that he will probably be called upon to produce a so-called pure beer by English barley malt, and he will have to buy foreign to supplant it.

6276. It was not the tax on the glucose or the sugar that was frightening him?—No; because he promised me he will continue to use my sugar notwithstanding the price.

6277. (Dr. Whitelegge.) In your own brewery you use glucose and invert sugar?—No; we do not use glucose.

6278. Only invert sugar?—Yes.

6279. What is the maximum proportion?—20 per cent.

6280. (Chairman.) Going back to the barley—Why is it not possible to fulfil the condition of nothing but malt and hops without introducing foreign barley?—The English barleys are so unripe and contain so much nitrogenous and albuminous matter that it is perfectly impossible to get the clarifying effect upon them without you have what is generally called more sun in your mash-tun.

6281. So that brewers are obliged to get barley from more sunny climes than our own to make a good result if it is to be an all-malt beer?—That is so.

6282. (Mr. Cosmo Bonsor.) As a brewer, there is no difficulty in getting beer free from arsenic?—No. Practically free, commercially free.

6283. You see no difficulty, either as a manufacturer of this glucose or as a brewer?—None whatever.

6284. Leaving the test of what is commercially free to a Government authority?—Distinctly.

6285. (Chairman.) In case the Commission would like to see the process of your manufacture, would it be convenient to you to allow us to come?—Distinctly, at any time.

Dr. NATHAN RAW, Medical Superintendent of the Mill Road Infirmary, Liverpool, called; and Examined.

Dr. N. Raw. 6286. (Chairman.) You are Medical Superintendent of the Mill Road Infirmary, Liverpool?—Yes.

6287. And consulting physician to the West Derby Union Workhouse?—Yes.

Epidemic in Liverpool less extensive than in Manchester. 6288. The recent epidemic of arsenical poisoning does not seem to have been so extensive in Liverpool as in Manchester?—No.

6289. You have put in a statement as to the number of patients admitted?—During the last three years, out of 12,823 patients admitted into Mill Road Infirmary under my care, there have been 225 cases of peripheral neuritis; of which number 153 have presented symptoms which might be attributed to arsenic. Of these 225 cases of peripheral neuritis 51 died, the apparent cause of death being general asthenia, with cardiac failure in most of the cases. As bearing on the question as to when the arsenical contamination of beer commenced, the statistics of this infirmary are of great value, and recent disclosures have proved that my suggestion that the poisoning commenced in May last is probably correct.

Statistics of peripheral neuritis at Mill Road Infirmary. The following table shows the number of cases of neuritis admitted into Mill Road Infirmary during the last three and a-half years:—

	1898.	1899.	1900.	1901 to April 22.
January	3	8	—	13
February	1	1	5	7
March	1	8	1	2
April	—	1	2	1
May	3	4	7	—
June	2	3	11	—
July	4	—	12	—
August	1	3	17	—
September	3	2	25	—
October	2	2	22	—
November	3	1	16	—
December	3	1	25	—
Total	26	34	143	23

6290. Your table shows that during the years 1898 to 1899 the number of cases of neuritis average thirty for the year, but a sudden increase was first noticed in the beginning of June?—Yes.

6291. Which steadily increased to the end of 1900?—Yes. In fact, the cases continued to appear until almost the middle of January; then they suddenly ceased, and I have not had a case for over nine weeks.

6292. Reviewing the epidemic as a whole, and after careful observation, what have you concluded?—Reviewing the epidemic as a whole, and after very careful observation, I have noticed the cases to be divided into two important classes: (1) The acute.—Of these I have only seen 17 cases. They occurred late in the epidemic, about the beginning of December, and presented a totally different set of symptoms from those of the more advanced or chronic cases. These cases had to the appearance of having been suddenly and acutely poisoned with a large dose of arsenic. The symptoms, although acute for a few days, soon passed off, and the patients made a rapid recovery, and in all cases were discharged recovered. (2) The Chronic Cases.—These formed by far the greatest number, and on admission presented the usual symptoms of peripheral neuritis, and had the appearance of some slow and chronic form of poisoning attributed at that time to alcohol. Although I have been in the habit of seeing cases of alcoholic neuritis for the last fifteen years, I had not noticed any difference in the character of the symptoms in patients admitted into this infirmary until the beginning of August, when a few of the patients showed a well-marked general pigmentation of the skin, which for want of a better diagnosis, was attributed to Addison's Disease. During the next three months six cases were diagnosed as Addison's Disease, although it was felt at the time that the cases were not typical of that affection. Of these six cases three died, and on post mortem examination no evidences whatever were found to confirm the diagnosis of Addison's Disease; on the contrary, the cause of death seemed to be alcoholic neuritis. It was not until the paper of Dr. Reynolds appeared at the end of November that my attention was directed to arsenic, and then, of course, the epidemic was explained, and steps at once taken to prevent its

Towards end of epidemic symptoms acute arsenical poison

Earlier cases resembled alcoholic neuritis.

Pigmentation then simulating Addison's disease.

spread. With regard to the cause of alcoholic neuritis I am convinced, from a very careful observation of a very large number of cases, that beer and porter are the general drinks consumed, by far the greater number being due to beer alone; but I have certainly seen cases of undoubted alcoholic neuritis in which the patients have only taken brandy or whisky. With regard to this point my experience whilst in charge of a large Scotch hospital for four years is of interest, as during the whole of that time I only saw four cases of peripheral alcoholic neuritis, and it is well known that the popular drink in Scotland is whisky. I believe also that the serious lesions are caused by the continual drinking of moderate quantities every day for prolonged periods, rather than to sudden outbursts where large quantities are taken and rapidly excreted.

6293. (Chairman.) What are the serious lesions to which you refer?—The paralytic symptoms.

6294. It is probable now that these lesions were due to arsenic?—The recent cases undoubtedly must have been accelerated by arsenic. The great majority of cases of ordinary alcoholic neuritis occur amongst women of the poorer classes, and in Liverpool it is the custom for these women to congregate in each other's houses and send for cheap beer during the whole of the day. By consuming it off the premises they get what is called "the long pull," which means that they get a good deal more beer than they ask for. I mention this because when a patient says she has taken a pint of beer a day, one can safely assume double that amount. I understand that in Liverpool this practice of giving the "long pull" has now been abolished.

6295. (Sir William Church.) Did the acute cases show traces of any pigmentation?—Not at all. In none of the acute cases was any pigmentation seen.

6296. With regard to the "long pull," do you mean that when they send to the public-houses for a pint they get two?—They get between $1\frac{1}{2}$ and 2 pints, if the beer is consumed off the premises. But if they consume the beer in the public-house they get the measure they ask for.

6297. When they send a jug they get a double pull?—Yes, which is generally half as much again or a little more.

6298. (Chairman.) 50 or 60 per cent. above the quantity they ask for?—Yes.

6299. They pay for a pint and get nearly two?—Yes.

6300. If drunk on the premises they get only the pint?—Yes.

6301. (Dr. Whitelegge.) Can you say how many of the 143 cases noted in your table as occurring in 1900 proved fatal?—Seventeen.

6302. (Chairman.) In the other cases would the cure be complete or is the constitution broken for life?—In some of the cases the paralysis apparently is permanent; paralysis of the legs and paralysis of the arms.

6303. (Sir William Church.) One has not had time yet to say whether it will be permanent. You will admit that paralysis from peripheral neuritis and paralysis arising from other causes, diphtheria, for instance, sometimes takes many months before it improves, and still more months before recovery is complete, but in most cases eventually becomes complete?—In most of them they certainly do, but some of them are very inveterate at present. Some of them have been under treatment for more than a year.

6304. (Chairman.) You use the expression "ordinary alcoholic neuritis"; do you consider that now should be modified in the light of later knowledge?—I certainly think that arsenic accentuates the symptoms of alcohol in producing neuritis to a very marked extent, but I am not at all convinced that you cannot have alcoholic neuritis without arsenic at all.

6305. The peripheral symptoms and paralytic symptoms?—Yes.

6306. (Dr. Whitelegge.) You mentioned three fatal cases attributable to Addison's Disease, which now you think probably were due to arsenic?—Undoubtedly they were.

6307. How would these cases appear in the Registrar-General's returns? Does the certificate of Addison's Disease remain?—Yes.

6308. (Sir William Hart-Dyke.) Would you rather wish to suggest to the Commission there is peripheral neuritis that may exist from pure alcoholic excess?—Yes.

6309. And there may be a disease where that exists, 4576.

but very much accentuated and increased in its intensity by the presence of arsenic?—That is my opinion.

6310. There are two types as it were. The type you were aware of before this scare existed, that is to say alcoholic poisoning?—Yes.

6311. But you have discovered since this scare that the mischief which may accrue to a patient from drinking too much alcohol may be accentuated enormously by the addition of small quantities of arsenic?—Enormously so. The presence of arsenic will produce very serious symptoms if in the presence of alcohol, but danger enormously increased by small quantity of arsenic.

6312. Would you inform the Commission if these same forms of paralysis may arise from arsenic without any alcohol at all?—Yes, they may.

6313. (Chairman.) With regard to the amount of arsenic in beer, what have you to say?—In some of the samples of beer examined by the Public Analyst of Liverpool as much as $1\frac{1}{2}$ grains of arsenic to the gallon was found. This, of course, was an extreme amount, and the general adulteration varied from one-thirtieth grain to one-tenth grain of arsenic per gallon. In one particular case of acute arsenical poisoning a man who had previously been a teetotaler for six months drank forty-two pints of beer in two days. On the second day afterwards he was seized with all the symptoms of acute poisoning, and on admission to hospital was very seriously ill. On examination of his urine arsenic was found in large quantity. The symptoms passed off rapidly, and within a fortnight he left the hospital quite cured. This is an example of a large amount of arsenic having been taken into the system in a short period of time, but in the great majority of the cases small quantities of arsenic had been taken spread over a prolonged period. In many cases patients would only admit to having taken small quantities of alcoholic liquors. The symptoms and appearance have been so ably and fully described by various observers that it is not necessary to refer to them here, but I have observed a few interesting points which, so far, have not to my knowledge been recorded.

6314. (Sir William Church.) In the case of this man who drank 42 pints of beer in two days, the symptoms of beer were gastro-intestinal?—Yes, and sensory symptoms drunk by too, very marked. Those were his chief symptoms. patients.

6315. But not followed by any permanent paralysis?—Not by any paralysis. His chief symptoms were extreme pain in his hands and feet.

6316. (Dr. Whitelegge.) Were those met with in the acute cases?—Yes, always.

6317. (Chairman.) Did the paralysis come after the Neuritis two days drinking?—He had no paralysis. He had extreme pain in the superficial nerves, but he has quite paralysis recovered.

6318. He had acute pain, neuritis, but not paralysis?—Yes, and no paralysis.

6319. Not many cases were met with taking small quantities of alcoholic liquors?—Beer and stout. Some from small of the patients had certainly only taken two pints of quantities of beer a day and two bottles of stout a day for some beer. months.

6320. Two bottles of stout would be about two pints, or a little more?—Yes.

6321. Did those patients who said they had only taken small quantities show signs of arsenical poisoning?—Yes; that was during the arsenic epidemic.

6322. (Dr. Whitelegge.) Were the cases which you have associated with very small consumption of beer severe cases or slight?—Some of them very severe.

6323. You are not inclined to affirm any direct connection between the amount used and the severity of the symptoms, without regard to the personal equation of course?—I do not think it has any bearing at all, taking into account the length of time they take the small quantities.

6324. (Chairman.) Assuming that it was true they had taken only a small quantity, the effect seems to have been accumulative with regard to arsenic?—Yes, and I think that is the important point.

6325. With respect to pigmentation?—Two kinds Arsenical of pigmentation are met with in arsenical poisoning pigmentation—one, which is a general darkening of the whole of two kinds. surface of the body, does not desquamate. This appears slowly and disappears very slowly. The other form is one in which the skin becomes dark in colour rapidly, especially attacking the flexures, the breast,

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and the front of the abdomen. The epidermis desquamates freely, and can be pulled off, leaving a normally coloured skin underneath. The first variety of pigmentation was met with in the earlier part of the epidemic; the second class only towards the end of the epidemic; and to my mind it seemed to suggest some rather serious increase of the contamination of beer.

6326. (Chairman.) Might it not be that they have been under the influence of contaminated beer longer? It might have been but I could not answer that for certain.

Return of
symptoms
though no
fresh arsenic
taken.

6327. Have you noticed any relapse?—I have noticed in two cases under my care at present a complete relapse of all the symptoms. The patients were apparently well; pain had disappeared, and the desquamation of the skin had been complete when, without any warning, a fresh attack of neuritis developed, as acute as before, with a general discolouration and desquamation of the skin.

6328. (Chairman.) Without more drinking?—Certainly. They had been in hospital all the time.

6329. (Dr. Whitelegge.) They were not taking iodide?—No.

6330. (Sir William Church.) In connection with these cases, did you make any examination of the urine during that time?—In both these cases arsenic was found in the urine shortly after admission.

6331. I mean at the time they relapsed?—No.

6332. Was it examined?—It was examined, but nothing was found.

6333. (Chairman.) No arsenic was found in the urine at the time of the relapse?—No.

6334. (Professor Thorpe.) With respect to the statement of this particular form of pigmentation you described which only occurred towards the end of the epidemic, and in your mind suggested some serious increase in the contamination of beer, what period of time do you mean of the epidemic?—Towards the last six weeks of the epidemic.

6335. What particular date would that be?—About the second week in December. We did not notice any desquamation of any case until the second week in December.

Arsenic in
urine.

6336. (Chairman.) Have you found arsenic in the urine in any cases?—I have been able to find arsenic in the urine in six cases out of 34 examined, but in no case was I able to find it after ten days from admission. I think Professor Dixon Mann has found it much later than that.

6337. (Sir William Church.) I ask with regard to these two cases. Dr. Dixon Mann has had certain cases in which there was a sort of relapse, but unfortunately in his case the urine was not examined?—Both mine were at once, and nothing was found.

6338. (Chairman.) What tests did you make?—I used the Reinsch test.

6339. With a considerable quantity of the urine?—I took 20 ounces of urine and evaporated it down to four slowly.

6340. So that that would be a very sensitive test?—I think that is the best test for urine.

Beer the
common
cause of
alcoholic
neuritis,
spirits
rarely.

6341. With regard to the cause of peripheral neuritis in general?—With regard to the cause of peripheral neuritis in general, I am of opinion that beer and porter are by far the commonest causes of the disease, yet I have seen undoubted cases caused by spirit-drinking. It is extremely difficult to get a reliable history of drinking from many patients, but I have had undoubted cases where the disease was produced purely by spirits. I have also seen cases of peripheral neuritis caused by the medicinal administration of arsenic in disease; these symptoms, however, have quickly passed off on the cessation of the drug.

6342. In the peripheral neuritis that you allude to now as resulting from spirits and not beer, was there paralysis?—Yes, marked paralysis.

6343. So that there is always paralysis in what you call peripheral neuritis?—Generally, yes.

Keratosis
common at
end of
epidemic.

6344. (Sir William Church.) With regard to this desquamation, did none of your cases present symptoms of keratosis?—Yes, large numbers.

6345. Did not any of the earlier cases present it?—No.

6346. Only the late ones?—Yes.

6347. So that there was no crust coming away

from your early cases?—No; there was nothing to distinguish the early cases from the ordinary cases we have seen for years.

Dr. N.
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6348. (Chairman.) What are your general conclusions?—After a careful observation of the epidemic I have come to the conclusion that the sensory symptoms are more pronounced in arsenical neuritis than in ordinary alcoholic neuritis, and, although very severe at first, they soon pass away. The motor symptoms tend more quickly to recovery under treatment than the purely alcoholic cases, and most of my patients have completely recovered, although a few are making little progress. When one considers the enormous number of people who have been drinking this beer, which has in some cases in Liverpool contained $1\frac{1}{2}$ grains of arsenic to the gallon, one is bound to think that some people are more susceptible to arsenic than others, as only a very small proportion has been attacked. It is apparent, too, that arsenic is a cumulative poison to some extent. It would seem also that the action of arsenic in the system is more virulent in the presence of alcohol than when given alone. So far as Liverpool is concerned the epidemic is at an end, and I have not had a new case of arsenical poisoning during the last nine weeks. It is just possible that with greater care in the manufacture of beer alcoholic neuritis may become much less frequent, and I have noticed that since the epidemic of arsenical poisoning in Liverpool the amount of alcoholism has very much decreased, a state of matters which I sincerely hope will continue.

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6349. Does that result from less excess in drinking?—I think so. I think it has given the community a great fright—at least we have noticed that in admissions to the hospital.

6350. (Dr. Whitelegge.) You say that the amount of alcoholism has decreased very much?—Yes.

6351. On what ground do you come to that conclusion?—On the admissions to the hospital. My hospital is confined entirely to the very poor, and the ordinary admissions suffering from alcohol are certainly very much less than they were.

6352. Including the remote effects from alcoholism?—Yes; general diseases which are produced by alcohol or accelerated by alcohol.

6353. For instance cirrhosis and ascites?—We have not noticed that so much, but ordinary delirium tremens, and things of that sort.

6354. You are thinking of groups of diseases in which there is already time for any recent causation to have made itself clear?—Yes. I do not know what the ultimate effect will be.

6355. Do you now regard alcoholic neuritis as existing apart from arsenic?—In my opinion, certainly.

6356. And with regard to the alcoholic neuritis which may exist apart from arsenic, do you attribute that to beer and porter rather than spirits?—In the majority of cases certainly.

6357. So that if arsenic were eliminated entirely from malt liquors, alcoholic neuritis would be a reality?—I think so, if taken in excess.

6358. And connected with malt liquors rather than with spirits?—Yes, if taken in excess.

6359. You told us of cases in which relapse occurred. Can you say at what interval the relapse occurred?—Ten weeks.

6360. (Sir William Church.) That leads me to ask one other question. If you think that alcoholic neuritis is more frequently produced by beer drinking than spirit-drinking why has there been such a large proportion of cases to the population in Liverpool and its neighbourhood, Manchester and Salford, than in London, which is a beer-drinking population?—In Liverpool and Manchester I think a very large amount of beer is consumed as compared with spirits.

6361. I am speaking of before beer was thought to be contaminated, in years gone by?—I cannot explain that.

6362. You would not like to express an opinion that the population there drink even more beer than in London?—No; I do not know at all.

6363. (Chairman.) Do you not think that some of the now known causes may have existed occasionally to a considerable degree in old times; that is to say, that some of those cases which are so closely analogous to the arsenical poisoning in their symptoms may have been due to unsuspected arsenic in the beer?—It is

quite possible that some of the symptoms may have been produced by very small quantities of arsenic spread over prolonged periods, but, of course, recently undoubtedly the arsenic has been in very large quantities, and so accentuated the symptoms.

6364. (Dr. Whitelegge.) Can you give us the proportion of the sexes in these cases?—I have the proportion as regards 132 cases, and I sent them to Dr. Buchanan, for his report to the Local Government Board.

WEST DERBY UNION INFIRMARY, LIVERPOOL.—Age and Sex of Peripheral Neuritis Cases.

	Under 20.	20-	30-	40-	50-	60-	70 and upwards.	All ages.
Males	—	5	12	17	6	3	—	43
Females	1	7	39	29	10	3	—	89
Total	1	12	51	46	16	6	—	132

6365. (Chairman.) Have you any evidence as to the number of deaths from the epidemic in the Manchester and Liverpool district, or the number under your own cognisance?—I have had 17 during the epidemic, and I have had 51 cases which have ended fatally out of the total number of cases. The 17 undoubtedly died from arsenical poisoning.

6366. (Professor Thorpe.) During this epidemic?—Yes.

6367. (Chairman.) Does anything else occur to you to tell us?—Bearing on the question which you yourself suggested, I have had four years' experience in charge of one of the large Scotch hospitals, and your remarks are certainly very important, because I saw only four cases of neuritis there out of 10,000 admissions. Beer was taken in very small quantities.

6368. That is a much smaller proportion than in Liverpool and Manchester before this large outbreak?—Extremely small.

6369. There was a larger proportion of neuritis than in Scotland before this outbreak?—Very much smaller percentage in Scotland, because they generally take whisky.

6370. And that was before the time of this outbreak?—Yes; I am referring now to seven years ago.

6371. (Dr. Whitelegge.) Where was that?—Dundee Royal Infirmary.

6372. Would the class of population make any material difference? The one is a Poor-law infirmary and the other a general infirmary?—The class of the population was almost the same, the working class.

6373. (Sir William Church.) Could you inform the Commission whether, in your opinion, beyond paralysis different sorts of alcoholic drinks appear to have rather different effects upon the human body?—In my opinion the neuritis which is caused by spirits is rather more paralytic in nature.

6374. Quite apart from neuritis, are there any other effects produced on the human body which are attributed to alcohol, and which differ a good deal in different parts of the kingdom? Perhaps you have never been much in London?—No, I have not.

6375. Are you aware that so-called gin-drinkers' liver which used to be attributed to the use principally of gin is found in Scotland?—Yes; I do not know how frequently, but it is fairly common there. The other lesions you find in the body are just as common in Scotland as in England, in my experience.

6376. Your experience is contrary to that of a great many others with regard to cirrhosis of the liver, hob-nail liver, gin-drinkers' liver. It used to be very uncommon in Edinburgh years ago?—I do not know.

6377. (Professor Thorpe.) Is the gin-drinkers' liver common in Liverpool?—Not very common. I saw more gin-drinkers' liver in Scotland than in Liverpool.

6378. (Dr. Whitelegge.) Contracted liver?—Yes.

6379. You have met with this in Scotland in association with whisky?—Yes; in many cases.

Cirrhosis of liver common there.

Mr. GEORGE E. DAVIS, called; and Examined.

6380. (Chairman.) You are chemical engineer and consulting chemist of the Manchester Technical Laboratory?—Yes.

6381. You have given us a statement, for which we are very much obliged to you, which will appear in our report?—Yes.

(The following is the statement):—

In order to thoroughly understand the present position of the sulphuric acid industry it is necessary to go back to the year 1870, when the trade was of much smaller dimensions than it is to-day.

In that year the manufacturers of sulphuric acid might well have been divided into two classes:—

(1) Those who manufactured the acid for their own uses, such as the alkali makers and the makers of phosphatic manures, and

(2) Those who manufactured the acid for sale to ordinary customers.

In the first class, but little other than Spanish pyrites was employed, and the two kinds of this ore mostly used were Mason's and Tharsis. At that time or soon after, the Rio Tinto mines were offering cargoes, but as the acid makers had become used to the manipulation of the Mason and Tharsis ores the Rio Tinto ore did not find much favour.

Moreover it was freely stated that the Tinto ore contained more arsenic than either Mason's or the Tharsis, and the influence of this upon the extraction of the copper that these pyrites contained was so uncertain that most vitriol makers preferred to use pyrites they did not know something of, rather than change to a source of which so little was known.

Then, again, this period was one in which a transition was being effected from an old method of working to a new. In the old method the kilns and chambers formed the whole of the vitriol plant, with in some cases a small steam tower at the end of them to prevent large escapes of gas into the atmosphere. In the new method (which was then so new that practically only a few of the alkali and manure makers had adopted it), a Gay-Lussac tower at the end of the chambers, absorbed

in strong sulphuric acid the nitrous fumes that formerly went into the atmosphere, and this acid was employed in another tower, called the Glover tower, to furnish nitrous fumes, that were led into the chambers with a flow of gas from the pyrites kilns. This tower was placed between the pyrites kilns and the first sulphuric acid chamber.

In 1871, in a works in South-East Lancashire with which I was connected, the new method was employed, and Mason's ore was used as the raw material.

This Mason's ore in 1871 contained 0.42 per cent of arsenic, and the sulphuric acid made from it contained at 140° Tw. or 1.7 sp. gr.:—4.3 grms. per litre of As_2O_3 —3.2 grms. per litre of As, or 0.19 per cent. As.

Upon going to St. Helens in 1874 the two works to which I was attached worked on the old system. Tharsis ore was burned here which contained 0.32 per cent. arsenic.

In these works there were no Glover towers, but a long and large iron flue intervened between the pyrites kilns and the vitriol chambers. In this flue a large quantity of the arsenic was condensed as As_2O_3 , and this was removed about once in six months. The deposit in this flue was very arsenical, as it contained over 54 per cent. of arsenic trioxide as well as some antimony and bismuth.

The acid made in these works contained:—2.26 grms. per litre of As_2O_3 —1.72 grms. per litre of As.—0.11 per cent. of As.

In another factory in the same town burning Tharsis ore (in 1875) the heat from the burning pyrites was utilised for concentrating the chamber acid by passing the flames over its surface, in a pan at the end of the pyrites burners, between them and the leaden chambers. In this case there was no flue in which the arsenic could deposit, and the sulphuric acid consequently contained more arsenic than usual, but not much more.

It was 2.66 grms. per litre As_2O_3 —2.02 grms. per litre As—0.12 per cent. As.

In what was the new system of working in 1870-7 the Glover tower placed between the pyrites kilns and the first leaden chamber acted practically as a washer and

Mr.
G. E. Davis.

Mr. G. E. Davis. 27 Apr. 1901. scrubbed the major portion of the arsenic from the gases by means of the vitriol that was showered down it. This is precisely the method of working to-day, and when the whole of the acid made in the establishment is poured down the Glover tower, the acid issuing from the tower contains the whole of the arsenic volatilised from the burning pyrites. The tower itself, however, does not wash out the whole of the arsenic from the gases; some arsenic goes forward into the first chambers of a series. But as this acid eventually finds its way down the Glover tower, it will be evident that the total arsenic is found in the outflow from the tower.

Arsenic in Glover tower acid and in chamber acid. During some investigations relating to the distribution of arsenic in a sulphuric acid plant, which I made in 1872, it was found that when the acid running from the Glover tower contained 4.3 grammes per litre of arsenious acid, the acid in the first chamber contained 1.6 grammes per litre, 0.3 grammes per litre in the second chamber, and mere traces in the last two chambers.

Of course it will be seen that if acid is taken out of the chambers without passing down the Glover tower, it will not be charged with its normal average amount of arsenic, and the acid running from the tower will then be more highly charged with arsenic owing to the smaller volume, and in such cases the percentage of arsenic is very high.

In one case that came under my notice the hot acid from the Glover tower contained 18.0 grms. per litre of arsenious acid when Rio Tinto pyrites was being used.

In the seventies, small quantities of coal pyrites (called "brasses") were burned, but the quantity was insignificant in works of the first class.

Arsenic in different pyrites ores. To-day the chief source of pyrites material is the Rio Tinto. This ore contains 0.40 per cent. of arsenic, and is very regular in its composition. Tharsis pyrites is burned still to a certain extent, Mason's to a very small extent, and there are several other mines sending their products to this country and known by various trade names, such as "Seville," "Santa Rosa," "Norwegian," etc.

Seville ore is very arseniferous; it contains 0.9 per cent. of As.

Santa Rosa is still more arseniferous, and often contains as much as 2.24 per cent. of As.

Sulphuric acid made in 1897 from Rio Tinto pyrites under my superintendence contained:—4.8 grms. per litre of As_2O_3 = 3.6 grms. per litre of As. = 0.21 per cent. As.

Norwegian ores are very variable in their composition. Some are free from arsenic, other varieties contain arsenic and copper, while some kinds contain so much selenium as to unfit them for many industrial purposes.

I may now pass to the second class of manufacturers, who, in 1870-80, manufactured the acid for sale to ordinary customers.

At this time, say 1871, most of the acid sold was rectified, water-white, vitriol of a sp. gr. of 1.840 or 1.64° Tw. Even when the acid was required by the consumer to be employed in the diluted state, he as a rule preferred the rectified acid, and to dilute it with water to his requirements. The two kinds in the market then were known as brimstone acid and pyrites acid. The brimstone acid makers used Sicilian brimstone, and the contracts were nearly universally made for "Sicilian brimstone," "Best Thirds," and it was from this quality that the whole of the "brimstone" acid was made in those days. At this time, 1871, and perhaps a few years before, sulphuric acid began to be made from spent oxide of iron, the refuse from gas works, and this was by many people regarded as a very fair substitute for brimstone acid in many cases. It had at that time no special designation, and at times it was not altogether free from arsenic. It had, however, a ready sale as it was a clean good acid, and for sulphate of ammonia making gave a good grey sulphate, which pyrites acid would not do.

From 1871 to 1877 the manufacture of sulphuric acid from spent oxide underwent considerable expansion, and the acid was a serious competitor with brimstone acid, so much so that the makers of brimstone acid went about to their customers decrying the acid made from "gas works refuse," as they called it; and several of them instructed their customers that such acid was not "brimstone" acid, and therefore ought to be classed with pyrites acid, which was lower in price.

This state of affairs was put before me in 1878 by a

firm then making about 80 tons per week of sulphuric acid from spent oxide, and I advised them that although most of the acid made from spent oxide was every bit as good as that made from "best thirds Sicilian brimstone," yet by no stretch of the imagination could it be "brimstone acid," and I advised that it should be called 'sulphur acid,' as spent oxide from gas works contains its sulphur in the free state. So it was called sulphur acid in many places, to distinguish it from brimstone acid on the one hand and pyrites acid on the other. Some works have called it oxide acid, and both these designations mean the same thing.

The extension of the manufacture of acid from spent oxide continued until the year 1886, when spent oxide became scarce, and its price tended upwards.

This set some manufacturers thinking that if the arsenic could be extracted from the vitriol during manufacture, lower grades of pyrites (that is ores containing more impurities, notably arsenic) could be profitably dealt with. These ores are those already mentioned such as the Seville and Santa Rosa. This was effected on a very large scale, and in 1887 began a movement which has not only had a serious effect upon the "sulphur" acid trade, but has nearly civilised "Brimstone" acid out of existence.

I have examined many samples of genuine brimstone acid and found them always arsenic free.

I have also examined many samples of sulphur acid made from spent oxide, and while they have been generally free from arsenic, many samples have been found to contain arsenic, but in traces only, often very minute traces.

I have also examined a very large number of samples of pyrites acids, but the results already given will sufficiently indicate their arsenic contents.

The arsenic existing in pyrites is found there as metalloïd arsenicum in combination with some heavy metal, generally copper, iron or nickel. When such a pyrites is burned in a current of air some of the arsenic is oxidised and volatilised; 70 to 80 per cent. of the arsenic leaves the pyrites on combustion. It has already been shown that when a long and cool flue intervenes between the pyrites kilns and the leaden chambers, some of the arsenious acid condenses therein, but still a large quantity passes on and finds its way into the acid of the chambers.

Under the modern system of working the interposition of the Glover tower between the pyrites kilns and the leaden chambers causes a very large proportion of the arsenic to be absorbed in the vitriol that is run down it, and this amount is kept out of the leaden chambers, so that the acid drawn from the chambers is much less arsenical than the Glover tower acid. It is certainly less arsenical than it would be if the Glover tower had not been interposed.

The vitriol running from the Glover tower is very hot, generally, 300° F. to 320° F., and usually of a sp. gr. of 1.75 or 1.50° Tw. At this temperature and strength a litre will dissolve about 60 grammes of arsenious oxide, or equal about 2.58 per cent. by weight of metalloïd arsenic. When, however, this arsenical acid is cooled down to the ordinary atmospheric temperature the greater portion of the arsenious acid crystallises out, and a saturated solution containing about 10 grammes per litre of arsenious acid is supernatant. This is equal to 0.57 per cent. by weight of arsenious acid, or 0.43 per cent. of metalloïd arsenic.

I have seen it stated in print during the past few months that a vitriol of commerce was found to contain 1.8 per cent. of arsenic, or four times as much as the above figures show an acid can hold in solution. This can be accounted for by the fact that the arsenious acid which crystallises out during cooling has not been allowed to settle out before sale.

There is also a further explanation. The arsenic existing in sulphuric acid made by the modern method occurs in two forms: arsenious acid and arsenic acid. The arsenic acid is more soluble in sulphuric acid than the former is.

The foregoing experiences show that it would not be difficult to so arrange the apparatus that from 70 per cent. to 80 per cent. of the arsenic contained in very arsenical sulphuric acid would be eliminated by cooling and subsidence. No invention would be required, but simply the application of known facts.

In all the works where pyrites vitriol is "de-arsenicated" the operation is performed by diluting the vitriol

Mr. G. E. Davis. 27 Apr.

Pyrites in recent years has been more arsenical than formerly.

No arsenic in genuine brimstone acid or spent oxide acid.

Soluble in vitriol of great specific gravity.

Mr. C. Davis. with water and precipitating the arsenic as sulphide by contact with sulphuretted hydrogen gas.

Apr. 1901. When the sulphuric acid is sufficiently diluted and kept cool it is possible to eliminate the whole of the arsenic, if the operation is properly conducted. Such acid is even better than acid made from brimstone for many purposes, as the sulphuretted hydrogen gas also purges the acid of its nitrous contents, which are very detrimental in some processes, such as the manufacture of aerated waters and the preparation of some colouring matters.

Irregularity of working cannot, however, be thoroughly guarded against in the de-arsenication of pyrites acid without much care in the supervision of the operations. The precipitate of arsenious sulphide is a very bulky one, and much sulphuric acid is entangled with it. It would not pay to lose this, and so the precipitate is washed and sometimes heated to facilitate the subsidence of the arsenious sulphide. During any process of heating some arsenious sulphide and also some antimony that accompanies the arsenic is re-dissolved, and if this solution is mixed with the bulk of the de-arsenicated acid arsenic will be found in the so-called purified acid.

There is one other point that deserves to be mentioned. The more arsenic in the raw acid the greater will be the bulk of the arsenious sulphide precipitate necessarily be, and consequently the greater trouble in the manipulations. When an acid maker sells two qualities of acid, viz., an arsenical acid and a de-arsenicated acid, it is to his interest to concentrate as much arsenic as possible into his common or arsenicated acid, say the Glover tower acid, so as to have less in his chamber acid to precipitate. In such a case the untreated acid would contain far more arsenic than the average acid of a maker who did not de-arsenicate at all. For some purposes perhaps this would not matter, but it is not a step in the right direction.

In 1878 I carried out a series of experiments for a firm, with which I was then connected, of eliminating the arsenic by means of a stream of hydrochloric acid gas, but it was found that it was only the arsenious acid that was eliminated. The arsenic present as arsenic acid still remained, and the process was discontinued as an imperfect one.

When arsenical sulphuric acid is used for the preparation of other acids the arsenic generally contaminates them. In 1876 a sample of phosphoric acid sent to me for analysis contained 2.6 grammes per litre of arsenious acid, and a sample of liquid muriatic acid recently examined contained 1.12 grammes of arsenious acid per litre. This last acid was made with sulphuric acid, the produce of Rio Tinto pyrites.

6382. (Chairman.) With respect to some of the chief points of your statement, we understand formerly the vitriol plant consisted essentially of kilns for burning the pyrites and chambers for making the acid, with the long flue to the kilns, in which a good deal of the arsenic condensed?—That was so.

6383. The introduction of the Glover tower in connection with the Gay-Lussac tower meant that in between the kilns and the chambers a washing tower was interposed?—Yes; that was called the Glover tower. It was for the purpose of boiling down the acid from the chambers. The acid was weak as it came from the chambers, and contained a great deal of water, and formerly, prior to 1870, it used to be boiled down in leaden pans, but the Glover tower was an invention to boil down this acid by means of the waste heat coming from the pyrites.

6384. The washing in this tower is done by sulphuric acid, which is continuously passed back from the chambers?—Yes.

6385. The washing in the tower takes up a large proportion of the arsenic?—Yes.

6386. In which of the substances concerned is the arsenic taken up?—The arsenious acid is in the state of vapour carried along with the sulphurous acid from the sulphur of the pyrites and the arsenious acid being a solid substance, whilst the other is a gas, the vitriol poured down this tower washes out the arsenic.

6387. Where does the arsenic washed out go?—Into the sulphuric acid.

6388. The Glover tower acid is thus highly arsenical?—It is.

6389. While chamber acid is much less arsenical?—

6390. And the amount of the arsenic diminishes from chamber to chamber?—Yes.

6391. The effect of the Glover tower has been on the one hand to enable pyrites acid from the chambers to be comparatively free from arsenic?—Yes, about one-third of the quantity that exists in the tower acid.

6392. On the other hand, it has caused the production of a commercial sulphuric acid from the Glover tower, which is much more arsenical than was made previously?—Yes.

6393. Are the acids from the chambers and from the Glover tower about equally strong as regards sulphuric acid?—Yes, about an equal strength of real sulphuric acid, or to be more exact, the chamber acid contains about 70 per cent. of sulphuric acid while the Glover tower acid contains 80 per cent.

6394. The cheaper and more arsenical ores, such as Serrille and the Santa Rosa, are coming into the market as well as the Rio Tinto ore; formerly it was Rio Tinto?—Nearly entirely; but now the Rio Tinto are putting up their price, and the world will be now searched for ores, perhaps not quite so pure.

6395. The Rio Tinto ore was a sulphuret of copper?—Yes, and iron.

6396. Which the most, iron pyrites or copper pyrites?—The iron pyrites, a bi-sulphide of iron.

6397. Is there much earthy or rocky matter along with this ore, or does the pyrites come out nearly free from earthy matter?—There is not very much impurity in the ore. I think the full amount of sulphur it can hold theoretically is 52 per cent., whereas it contains from 49 to 50.

6398. Which contains?—The ore contains from 49 to 50 in practice, and it can only hold 52 theoretically, so that it is very nearly pure pyrites.

6399. When very arsenical ores are used, the manufacturer makes both arsenical and non-arsenical acid?—Generally.

6400. And he has a special reason for trying to get as much arsenic as possible into his Glover tower acid?—Yes, when he de-arsenicates.

6401. Does he de-arsenicate the Glover tower acid generally?—Not if he can help it, because it contains too much arsenic.

6402. Why does not he?—When the sulphuretted hydrogen is passed through this strong acid, there is so much sulphide of arsenic that perhaps two-thirds of the settling-tanks would be filled with this material, and he would be only able to draw off from these tanks about one-third of the acid he treated.

6403. What remains in the mud, has that to be got out?—Yes. And that is why he would rather not treat this strong acid.

6404. He could purify the whole of it?—Yes.

6405. Is it an expensive process?—Much more expensive than treating the chamber acid only.

6406. Treating the chamber acid to purify the arsenic is not a very expensive process?—No, because there is a small quantity of arsenic in it.

6407. It makes a very small difference on the price of the finished product to purify it from arsenic?—I think I have read some of the evidence, but I think it chamber is minimised rather. It does cost a few shillings per acid ton.

6408. Two or three shillings?—It might go up to 5s.

6409. 5s. out of 45s. perhaps?—Yes. It would vary, perhaps, from 1s. to 5s., according to the amount of arsenic that is present in the acid.

6410. What do they do with the Glover tower acid—sell it?—It is sold to these people, to whom arsenic is no damage, such as the manure makers.

6411. Is arsenic no damage to them?—I have not followed the question out.

6412. Would not putting so much arsenic into the manure make it liable to get into the roots, or even into the plants?—I have not followed that subject out.

6413. The arsenic found in the refuse of the Glover tower acid is not a product of any value?—No, not at present. It has been tried to utilise it, and I think one or two manufacturers do in a small way, but I don't think there is any great use for the whole of it.

6414. It is sulphide of arsenic?—Yes, it is.

Mr. G. E. Davis.
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Ores coming into the markets increasingly arsenical.

Tower acid generally?—Not if he can help it, because it contains too much arsenic.

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- Mr. G. E. Davis. 27 Apr. 1901. 6415. Arsenium and sulphur?—Yes.
6416. It would be a dangerous thing to throw out?—It is very insoluble. I do not think it would do much harm on an ordinary waste heap.
6417. Could you get quit of it in a rubbish heap?—Yes, in the ordinary rubbish heap of the works, which is a mixture of everything.
- Sulphuric acid super-saturated with arsenic, 6418. The Glover tower acid when hot can dissolve about six times more arsenious oxide than when cold; is that so?—Yes.
6419. Hence when we have been told of a commercial acid in which a deposit of crystallised arsenious oxide was found, we may infer that the amount of arsenic might have been materially diminished by simply cooling and decanting?—That is so.
- may be sold without declaration. 6420. And such acid may be sold without a special note that it contains arsenic?—Yes; I do not think any note is made as a rule in selling acids, whether it contains arsenic in any greater or less degree.
6421. That would be highly poisonous if, by chance, a few drops of the sulphuric acid was used in medicine and various ways?—Very poisonous indeed. It ought not to be used for food.
6422. Do you know whether sulphuric acid is used in any acidulated drops or other confectionery?—I think vegetable acids are used for that, citric and tartaric.
- Citric and tartaric acids liable to be arsenical. 6423. Is sulphuric acid ever used for cheapness; it is as wholesome as any other if it is not too strong?—I do not think it is used because there is a peculiar taste about the vegetable acids. On the other hand citric and tartaric acid are both made with sulphuric acid as a basis, and the arsenic in sulphuric acid would probably get into the citric or tartaric.
6424. Would you approve of allowing what you call Glover tower acid to be sold at all without a notice that, although called sulphuric acid, it contained a large amount of arsenic?—I think so. I think it should be used for certain purposes. I think caution should be exercised by the people who are going to use it.
6425. It does seem rather dangerous to sell a sulphuric acid without note or comment, a liquid containing as much arsenic in solution?—It is dangerous for food stuffs.
- Arsenic acid in sulphuric acid. 6426. Cooling the sulphuric acid from the Glover tower process would not remove much of the arsenic which is present as arsenic acid?—No; it would remove none that was present as arsenic acid.
6427. It would remove crystals of arsenious acid?—Yes.
6428. How is the de-arsenication of chamber acid effected? Is that by the aid of sulphuretted hydrogen?—Yes, that is how it is done at present.
6429. Diluting and precipitating. Is there any other substance required to precipitate it?—No.
6430. You simply dilute the acid and precipitate by sulphuretted hydrogen gas?—Yes.
6431. Must the acid be diluted?—Yes, because arsenic is not wholly precipitated without you reach a certain degree of dilution; in the strong acid precipitation does not take place.
6432. The result is completely arsenic-free acid, but considerably diluted with water?—Yes.
6433. Is it not rather an expensive process to dilute the acid, precipitate the arsenic, and afterwards strengthen the acid?—No. It only costs, I should think, on an average, something like 3s. 6d. a ton.
6434. Does that include the re-strengthening of the acid?—Yes.
6435. Is it possible in this way to produce a completely arsenic-free acid?—It is.
6436. Can arsenic-free in this sense mean that no arsenic could be found by any test in a quantity such as an ounce of acid?—Yes; it could be entirely precipitated from it.
- Arsenic can be completely removed from chamber acid. 6437. With regard to arsenic in brimstone acid and spent oxide acid, have you found brimstone acid made from Sicilian sulphur uniformly arsenic-free?—Always; when I have been able to prove to my own satisfaction that the acid has been really made from Sicilian brimstone it has been always free from arsenic.
6438. Have you ever found any arsenic whatever in sulphuric acid made from Sicilian sulphur?—No, I have not.
6439. Have you tested a great many samples?—A great many.
- Mr. G. E. Davis. 27 Apr. 1901. 6440. We have been told that it is sometimes found in acid made from Sicilian brimstone?—I have found arsenic in acid which has been sold as brimstone acid, but which afterwards I found out had been made from something else.
6441. What else?—The spent oxide from a gas works, and coal pyrites.
6442. Spent oxide gives you sulphur?—Yes.
6443. But mixed with some other impurities?—The first sample I ever tested of spent oxide acid contained traces of arsenic, and I followed the whole question up, and I found it was due to hydrochloric acid containing arsenic having been used to prepare the oxide of iron that went into the gas works in the first place.
6444. How much sulphur is there in the spent oxide supplied for this purpose?—It varies from 40 to 55 per cent.
6445. Which may have been contaminated by arsenic in the way you described?—Yes, sometimes.
6446. The arsenic is introduced through impure hydrochloric acid, but by using pure hydrochloric acid in the process the spent oxide sulphur would be free from arsenic?—Yes, quite free.
6447. That is a by-product from the gas works?—It is.
6448. Is any process of de-arsenication carried out at any works which produce brimstone acid or spent oxide acid?—No; it is not necessary.
6449. It is generally considered that the sulphuric acid which is produced, whether from brimstone or spent oxide, is arsenic-free?—It is generally free enough for all practical purposes.
6450. But you say that in a specimen which was called brimstone acid you found arsenic, and traced that back to spent oxide?—Yes.
6451. Then spent oxide without a special test for its purity does not give security against arsenic in the final product?—No; but the quantity is very small, mere traces. It does contain sometimes arsenic.
6452. When sulphuric acid containing arsenic is used for the preparation of other acids, the acid generally contaminates them?—Generally it does.
6453. In what cases may arsenical acid be used for the preparation of other acids?—Some years ago it was very largely used in making phosphoric acid; it is used in making acetic acid. All these things are matters of history; they are mostly detailed in "Gmelin's Handbook of Chemistry." The arsenic is found in these acids on account of pyrites sulphuric acid having been used for the preparation of these other acids. It is mentioned in Gmelin's handbook that acetic acid has been found in Germany to contain arsenic, which was traced to pyrites acid, and the quantity I found some years ago in phosphoric acid was rather large.
- Arsenic in acetic acid. 6454. Derived from arsenical sulphuric acid?—Yes.
6455. That is an enormous quantity that you found in 1876, 2·6 grammes of arsenious acid per litre?—Yes, and that was being sold at that time for sugar refining.
6456. The phosphoric acid was used for sugar refining?—Yes. The juice was treated with lime and the excess of lime was taken out by phosphoric acid.
6457. Was there any poisoning by the sugar so produced discovered?—I daresay in those years it would be put down to neuritis.
6458. With regard to the sugar that was treated by impure phosphoric acid, were there tests known to have been made?—I do not think so.
6459. You found a sample of phosphoric acid ready to be used for purifying sugar?—Yes.
6460. Containing as much as 2·6 grammes per litre?—Yes.
6461. That is a $\frac{1}{2}$ per cent. by weight?—Yes. In 1876 a sample of phosphoric acid sent to me for analysis contained 2·6 grammes per litre, of arsenious acid.
6462. Of arsenious acid per litre of phosphoric acid?—Yes.
6463. (Professor Thorpe.) Do you really mean that?—Yes.
6464. Was it a solution of phosphoric acid?—Yes. In those years it was sold as a liquid concentrated to 1·40 Twaddle, 1·7 specific gravity.

Mr. E. Davis. 6465. Phosphoric acid is now usually sold in a solid condition, is not it?—Not for manufacturing purposes. It is for finer chemicals, the glacial, but this was made by treating phosphate of lime with sulphuric acid made from the copper pyrites and then boiling down the liquid resulting from that, after separating the sulphate of lime. One works used to turn out about 20 tons a week.

6466. (Chairman.) You found recently a sample of liquid muriatic acid containing 1·12 grammes of arsenious acid per litre?—Yes.

6467. This last acid was made with sulphuric acid, produced with Rio Tinto pyrites?—Yes, and that is a very good average sample.

6468. (Sir William Church.) You say that by a process of cooling the Glover tower acid you would get rid of a good deal of the arsenious acid, but the arsenic acid would not be affected by that?—It is about one-third of the total quantity present there as arsenic acid, and if this acid is worked over these towers several times some of this arsenic, as arsenious acid, might separate out in the tanks by crystallisation, but the arsenic acid does not crystallise out. So that if it goes over the tower two or three times, pumped in at the top, and running out at the bottom, although a great deal of arsenious acid is separated out, the arsenic acid is continually increasing, so that that accounts, I think, for some of the acid one has read of in the papers being so strongly charged with arsenic. It was stated at the coroners' inquest that there was 1·8 grammes per litre in some of the acid, and that is a great deal more arsenic than ordinary acid will hold in solution. The only way to account for that is that it was present there as arsenic acid to a great extent, which does not separate out by crystallisation.

6469. (Chairman.) Does arsenic acid escape some of the tests that are applied?—It might do, but I do not think it does as a rule. The fact is, that when you pass sulphuretted hydrogen through a solution of vitriol containing arsenious acid and arsenic acid, the arsenious acid is converted into sulphide first, and the arsenic acid that is there does not form a sulphide until a considerable time. First of all, it has to be reduced by the sulphuretted hydrogen going through it to the state of arsenious acid, and then the arsenious acid is converted into sulphide, and that forms a very good practical test when one is de-arsenicating acid, because the sulphuretted hydrogen saturates the solution, and if, after standing a few hours, you find the acid no longer smells of sulphuretted hydrogen you know you have not passed enough through, and that some of the arsenic acid that is there perhaps has not been thrown down.

6470. The precipitation of sulphuretted hydrogen, if conducted long enough, will throw down all the arsenic acid after the arsenious acid?—Yes.

6471. First, the arsenious acid, and then given a continuation of the process, the whole arsenic acid will be thrown down?—It will.

6472. (Professor Thorpe.) What do you precisely understand by brimstone acid?—Acid made from Sicilian brimstone.

6473. Would you not understand by brimstone acid, acid made from spent oxide?—Certainly not.

6474. Although, of course, in the spent oxide it is a sulphur from which the stuff is produced?—Yes; but I make a distinction between sulphur and brimstone; brimstone is the native article, sulphur is a manufactured substance.

6475. Is that distinction always recognised in the trade?—It was in those early days.

6476. Is it now?—I would not like to say now. I have not had anything to do with the brimstone trade for 10 or 12 years; but I should not think it was.

6477. It would not be right for a manufacturer to designate as brimstone acid an acid made from sulphur which may be contained in spent oxide?—Certainly not. I should say it was quite a wrong thing to do.

6478. And you think in making that assertion you

would be supported by the general opinion of the trade?—I think so.

6479. Taking brimstone acid in your sense, can you tell the Commission the relative proportion of brimstone acid to pyrites acid made in this country?—No, I could not without getting statistics, and those are very difficult to get just now, because many manufacturers make the pyrites acid for their own use, and nobody but themselves have the statistics. It could be only got by taking the total quantity of pyrites coming into this country, and then supposing it was all used for one purpose.

6480. I presume all the pyrites that comes into this country from those sources, at all events, you have mentioned, is used in the manufacture of oil of vitriol?—I think so; but the bulk of it is used up again in the works where it is produced. It does not go outside to customers at all.

6481. I am quite aware of that. A large quantity is used in the alkali trade and in the manure trade?—Yes.

6482. Therefore it does not go into general consumption?—No.

6483. Would you call acid made from recovered sulphur brimstone acid?—No; I should call that recovered sulphur.

6484. Is that a term recognised in the trade?—Yes, it is always sold as sulphur, and generally recovered sulphur. The acid that was made in those years when brimstone acid was being made to be sold to consumers was always specified in the contracts that it should be Sicilian brimstone, best thirds. There were several qualities of brimstone, firsts, seconds, and thirds. Thirds were divided into one or two grades again. The first was too expensive to make vitriol of, and the second quality was considered to be so, but the best thirds, that is, the first grade of the third quality, was always selected for brimstone making; so that it was a very definite thing in those years. It was best thirds, and the whole of the brimstone acid in those days were made from that quality.

6485. (Chairman.) Did the firsts and seconds contain sometimes arsenic?—No.

6486. The best thirds was better quality than the first and seconds?—There was more rock with the third, which they would not have in the first and second quality. The first and second quality was generally 99·9 per cent. of sulphur, but the best thirds was 95 to 97.

6487. In Germany is the acid made chiefly from brimstone acid or chiefly from pyrites?—Chiefly from pyrites.

6488. Is there much brimstone acid made in Germany?—I do not think so.

6489. Is it easy to get arsenic-free acid in Germany?—Yes, there are de-arsenicating plants working in Germany.

6490. But ordinary German pyrites acid is as liable to contain arsenic, and contains as much arsenic as English made pyrites acid?—Quite so. They have methods of taking it out with sulphuretted hydrogen in much the same way as we have.

6491. They have a Glover tower?—Yes.

6492. And your remarks about the Glover tower and the difficulty of purifying the Glover tower applies equally to the German mode of manufacture?—Yes.

6493. (Dr. Whitelegge.) At the end of your print you mentioned a large proportion of arsenic being contained common in hydrochloric acid; is that general?—Yes, that is very general.

6494. Is hydrochloric acid used much in the preparation of food substances?—It is used a little. In the making of dextrin and even glucose it is quite permissible to use hydrochloric acid.

6495. And when hydrochloric acid is used it is necessary to take the same precautions against the presence of arsenic as in the case of sulphuric acid?—That is so.

Mr. G. E. Davis.
27 Apr. 1901.

Most pyrites acid used up at place of manufacture.

Acid from recovered sulphur.

German sulphuric acid made from pyrites.

hydrochloric acid.

(Sir William Church in the chair.)

Mr.
G. E. Davis.
27 Apr. 1901.

Hydrochloric
acid for food
purposes
should be
cylinder acid.

Selenium in
sulphuric
acid.

Sulphuric
acid from
recovered
sulphur,
contains no
sensible
quantity of
arsenic.

6496. (Dr. Whitelegge.) Are those precautions generally taken?—There is another circumstance, if you will allow me. Hydrochloric acid, that is used for food stuffs, as a rule is what is called cylinder acid; that is, it is not made in the ordinary way from pyrites. It is made from brimstone acid in the first place, in cylinders, and in much smaller quantities. Perhaps only two or three tons a week would be made in a cylinder, whereas you would make 150 tons a week in the ordinary furnaces. There is more care taken, and the price is about two or three times that of what is made in the large way, so that when a man wants to use hydrochloric acid for food stuffs he generally buys what is called cylinder acid.

6497. Which would contain a little arsenic?—It would not be contaminated with arsenic if it were made from brimstone acid. The difficulty is in the buyer finding out that it contains arsenic without testing it. That is why I think the onus of the acid being pure should be put upon him. He goes about to the cheapest market to buy as cheaply as he can, and he does not know until it is too late that an acid he is buying is made from pyrites instead of brimstone. He would know it if he were testing the substance he was buying.

6498. You mention that the Norwegian ore occasionally contains selenium?—Yes.

6499. Can you tell us anything about the presence of selenium in sulphuric acid?—It is present sometimes in small quantities, very small quantities indeed. It generally shows itself by volatilising into the hydrochloric acid when hydrochloric acid is made from it. Otherwise you do not find its presence very marked. It has a peculiar property of turning the hydrochloric acid after a time red, and a deposit forms in the carboys in which it is put of a blood-red colour, which people, as a rule, who are not chemists, fancy is iron. I have known of a good many carboys of acid having been returned to the makers with this deposit in the bottom, with the information that they could not use it because of the iron in it. That iron has been found to be selenium.

6500. In the sulphuric acid would it make itself felt?—No.

6501. (Professor Thorpe.) Has it not a power of turning sulphuric acid a particular colour?—It may have, but that colour is always masked by impurities in the sulphuric acid. In a large works the sulphuric acid is almost always brought into contact with some organic substance, and instead of getting a clear acid it is generally brown from the presence of organic matter.

6502. (Dr. Whitelegge.) Would selenium be only found in acid from Norwegian ores?—Yes, in any considerable quantity.

6503. Is much of the sulphuric acid on the market prepared from Norwegian ore?—Not much. It is a very difficult ore to work, and, therefore, it has not found much favour.

6504. So that in general one would not expect to find selenium in any sulphuric acid?—Not in a quantity to do any damage.

6505. Can you say anything as to the proportion in which selenium would be present as a maximum in the Norwegian ore?—No; I have never determined the quantity.

6506. (Professor Thorpe.) To come back to where I left off. You told us that sulphuric acid made from recovered sulphur would be known in the trade as sulphur acid?—Yes.

6507. Recovered sulphur may contain a little arsenic, may it not?—I do not think it is likely when made by the Chance process. It is all made from sulphuretted hydrogen volatilised by means of carbonic acid.

6508. You think that recovered sulphur would not contain any sensible quantity of arsenic?—Not any sensible quantity. The acid from it would be quite as good as if made from brimstone, but it is not brimstone acid for all that.

6509. The introduction of the Glover tower has effected considerable economy in the manufacture of sulphuric acid?—Yes.

6510. It has done that, I presume, by employing the heat of the gases as they come from the kilns in concentrating the oil of vitriol?—That is so.

6511. In order that that heat may be in a maximum quantity it is necessary that these gases must be delivered as promptly as possible from the kiln into the Glover tower?—Yes.

6512. Therefore there is no intermediate cooling process which would allow of the deposition of the arsenious oxide?—No, we always try to make the flue as short as possible.

6513. In the old-fashioned system there was time given for a deposit of the arsenic?—Yes.

6514. In the old-fashioned method of making oil of vitriol there was a less chance of any large quantity of arsenious oxide getting into the oil of vitriol?—Yes; it used to settle in the cooling flue, and was taken out generally twice a year. The plant was stopped for cleaning the long flue out. We used to clean out in one particular flue I remember three or four cart-loads of arsenic at a time.

6515. Therefore the effect of this economy has been to bring about the possibility of a larger introduction of arsenious oxide into the acid?—Yes.

6516. But as the method is at present worked, that arsenious oxide is largely concentrated in the Glover tower?—Yes.

6517. These acids of which we read in the newspapers, and which have been connected with the formation of arsenical glucose, were they, in your opinion, probably Glover acids?—They must have been direct from the Glover tower.

6518. And therefore must have contained the maximum possible contents of arsenic?—Yes. I have never seen such samples myself in the whole of my experience.

6519. (Sir William Church.) You saw examples of the acid that had been used?—No, but I have seen the results.

6520. You are judging from the analysis?—Yes. I have never seen such results.

6521. Is it common to get actual deposit of arsenic as a sediment from Glover tower acid?—Yes, it is, in the works themselves, but not in customers' tanks outside.

6522. To be sent out?—No.

6523. (Professor Thorpe.) If you object to give an answer to this question you will say so; but do you think it would be a proper thing for any oil of vitriol maker to send Glover acids to persons calling themselves sugar refiners?—Not if they knew they were sugar refiners; or for the preparation of food of any kind.

6524. It has been suggested to us that it would be desirable to prescribe that whenever sulphuric acid is used for food purposes it should be brimstone acid; do you think that is necessary?—No, I do not think that is necessary at all.

6525. You believe that the methods of de-arsenicating oil of vitriol are so effective that purified oil of vitriol could be obtained with certainty?—Yes.

Mr.
G. E. Davis.
27 Apr. 1901.

Concent-
ration of
arsenic
in Glover
tower.

De-arsen-
icated
acid
suit-
able for
food
purpose

THIRTEENTH DAY.

AT WESTMINSTER PALACE HOTEL.

Friday, 3rd May, 1901.

PRESENT :

The Right Hon. LORD KELVIN (in the Chair).

The Right Hon. Sir WILLIAM HART-DYKE.
Sir WILLIAM CHURCH.
Professor THORPE.

Dr. WHITELEGGE.
Mr. COSMO BONSOR.

Dr. BUCHANAN, *Secretary*.

Sir HENRY W. PRIMROSE, K.C.B., C.S.I., called; and Examined.

6525.* (*Chairman*.) You are the Chairman of the Board of Inland Revenue?—Yes.

6526. Your Board possesses considerable powers over breweries?—We do.

6527. These powers have been given in one respect for the protection of the Revenue?—Speaking generally, I think we may say so.

6528. But not merely for the protection of the Revenue?—The powers given us under the Act of 1888 go rather beyond that; otherwise I should say they were confined wholly to the protection of the Revenue.

6529. The Revenue is derived from the sale of certain objects?—That is so.

6530. It might be presumed that the Government in getting Revenue from the sale of objects would itself as far as possible guarantee the healthfulness of those objects by the sale of which it makes money?—I am not quite sure that that has been the view of the Government.

6531. Does it seem to you right that the view of the Government should if necessary be altered so as to adopt that conclusion?—That is a large question of policy. As regards the actual fact I do not myself read the law as implying that hitherto we, as representing the Government, are responsible for the wholesomeness of the taxed article.

6532. There is a Revenue Act, or Acts, which might conceivably be utilised for the protection of public health?—That is so, certainly.

6533. If it could not be conceivably so utilised, would not the Act need amendment?—If it was desired to impose more direct responsibility upon the Department no doubt the law would have to be altered.

6534. But is it not right that the contingency of making money from the public by selling poisons, or injurious ingredients, should be provided against?—I think it may be provided against in another way: by making the persons who sell the article responsible, rather than by making the Government responsible who merely take a tax upon the article.

6535. To secure that no article liable to tax shall pass without taxation it is necessary to analyse some of the products?—Yes.

6536. Ought not the law to be that in analysing those products care is taken—not merely may be taken, but shall be taken—that the products are not injurious? There is an opportunity of testing; in fact, there is an obligation to chemically test the articles on which the tax is leviable?—Yes.

6537. Is it right that the articles should pass through the hands of an analyst of the Revenue and pay tax and yet be poisonous?—The analyses required to test for purposes of health, I take it, is different from the analyses required for the test for the purposes of Revenue. Therefore it would be an additional duty imposed if we had to test for soundness of condition.

6538. Is not that a duty that is owed to the public from whom the money is taken?—I should not like to express an opinion upon that.

6539. The Act is framed so that it can be conceivably utilised for the protection of public health?—Yes.

6540. Is it not right that as far as that is conceivable or possible in the Act it ought practically to be done?—I think a great deal would depend upon what was proposed. I should say it would not be of practical advantage to make the Department primarily responsible, because I think it would interfere very seriously with the convenience of the trade. Everything would be sent up to one central laboratory, which would have to be considerably enlarged if they were to analyse very closely and carefully the whole of the produce of the breweries from the point of view of public health, and the analyses would probably be very considerably delayed by them. In the meantime very much of the produce would have gone into consumption, or may have gone into consumption. I should say myself that that is a duty which would be better entrusted to the various localities. The mere fact that the article is taxed ought not necessarily to make any great difference as compared with articles that are not taxed. The locality is responsible for all articles of food and drink that are sold, and I think it would be better to leave to them that responsibility with regard to beer in the same way.

6541. And not to include any protection of the public against poison in the analyses that are made for protection of the Revenue?—I think it would add very largely to the business of the Central Government Laboratory, and I think it would be a pity to make the Central Government Laboratory primarily responsible for that investigation. I think its proper function is rather that of a court of appeal or referee in disputed cases.

6542. Has in fact the clause in the 1888 Act as to noxious ingredients been acted on?—No, not as regards noxious ingredients; it has been acted upon once as regards a material or substance which was considered to be injurious to the Revenue, namely, saccharine. As soon as the Act was passed a notice was published in the "Gazette" prohibiting the use of saccharin. Perhaps I may hand in a copy of that prohibition. It says that the "use of the said extract or product is calculated to affect prejudicially the interest of the Revenue." And thereupon the use of it was prohibited. That is the only order that has been issued under the Act of 1888; and in no case has any order been issued prohibiting the use of a substance on the ground of its being noxious or deleterious.

6543. (*Sir William Hart-Dyke*.) As regards health?—Yes.

6544. (*Chairman*.) So that I may take it your answer to the question: Has the clause in 1888 Act as to noxious ingredients been acted upon, is No?—Yes, the answer would be no.

6545. Without reservation?—Yes.

6546. Can you give a synopsis of the powers which are actually possessed under the Act of 1888 and of the powers of the Board of Inland Revenue under any other Acts which may bear on the protection of the

Sir H. W. Primrose.

Objections to making Board of Inland Revenue primarily responsible for purity of beer.

Under 1888 Act Saccharine prohibited for revenue reasons.

but no ingredients on ground of risk to health.

Sir H. W.
Primrose.

3 May 1901.

Powers of
Excise at
brewery.

public health?—I have a note here of those of the powers which might possibly be utilised for the protection of the public health; it by no means includes all our powers, but includes, I believe, all those germane to this Inquiry. Our first Act is the Act of 1880; an Act which substituted a beer duty for the malt duty, 43 and 44 Victoria, Chapter 20. Under that Act every brewer of beer for sale is required to take out a licence and to make entry of his premises, and we have power to visit the premises at any time. Under Section 26 we are empowered to take samples of any worts, beer, or materials for brewing in the possession of the brewer. That is the material provision as regards this Inquiry, that we have power to take sample at any time of practically anything in the brewery. Then we come to an Act of 1885, which amended the Act of 1880 to a certain extent, and that gives us certain powers over the use of sugar by brewers, and it requires that they shall keep a sugar store, and that they are prohibited from receiving sugar unless accompanied by an invoice from the seller containing the particulars thereof. The Commissioners of Inland Revenue are empowered to require by a notice served upon the brewer that an account of all sugar received shall be kept; and upon the notice being made the brewery is required to deliver to the officer of Inland Revenue all the invoices relating to the sugar subsequently received. Perhaps I had better put off until later saying exactly what we have done under these different clauses. I will for the moment merely go through what our powers are. Under another section of that same Act a brewer of beer for sale is prohibited from adulterating beer or adding any matter or thing thereto, except finings for the purpose of clarification, or other matter or things sanctioned by the Commissioners of Inland Revenue. The only other important provision is that in the Act of 1883 to which reference has been already made, and which enables us to prohibit the use in brewing of any substance or liquor of a noxious or detrimental nature, or which, being a chemical or artificial extract or product, may affect prejudicially the interest of the Revenue. That is a short statement, I think, of the powers that might be useful in connection with this Inquiry.

6547. The sampling and examination of materials in works is permitted?—Yes.

Object of
sampling by
Excise
Officers.

6548. Is it practised as a rule or only in cases of appeal?—That is practised regularly. I think I may say there are two main objects; one is to check the brewing value of materials, especially of any new materials. Supposing any new material is introduced as a material for brewing, we should have to estimate its value for brewing purposes, and assign it a value relatively to malt—malt on one side or sugar on the other.

6549. (Mr. Cosmo Benson.) As regards its product?—Yes.

6550. (Chairman.) That is done regularly in every brewery?—That would not be done merely for the purpose of checking brewing materials but only when there was some special reason. That perhaps would come under the second object for which we take samples of materials and wort, viz., to check the returns of the brewers and of our own officers of the results of the brewing. Where there is any suspicion as to the correctness of such returns samples of materials and wort would be specially taken. For instance, if we found that the produce of a brewery was habitually less or more than what would have been expected from the materials entered, because I may mention that the brewer before he begins to brew has to enter the whole of the materials that he proposes to use in that brewing—although we do not charge on that we use that as a means of testing the correctness of the results of the brewing on which we do make the charge—if it were found that the results of brewings were suspiciously large or suspiciously small, then we should take special samples. Otherwise we merely follow a prescribed course. Our officers are told to take samples at certain stated intervals, not regularly, but from time to time, and to send them up to the laboratory for testing. There is another occasion upon which samples must be taken of the wort, and that is, if before our officer has taken an account of the wort the fermentation has begun, then a sample is taken in order to determine what the original gravity was, because the gravity would have changed owing to fermentation having begun. Speaking quite generally, the principal object I should say of taking samples is

System of
sampling.

to check the returns made by the brewers and by our own officers upon which the duty is assessed.

Sir H.
Primrose.

6551. And that is done practically from day to day, even when no question arises?—Yes, that is being constantly done.

6552. With regard to the receipt and storage of sugar, by sugar is meant what?—Sugar and all its equivalents, legally everything that is not malt and corn is sugar.

Known
by Ex-
"sugar"
stored
brewer

6553. Cane sugar, if it was in the brewery, would be included?—Yes.

6554. Glucose would be included?—Yes.

6555. And inverts?—Yes. Under Section 7 of the Act of 1885 we have very considerable powers, but as a matter of fact we have not found it necessary to enforce them in all respects. We practically content ourselves as regards sugar with requiring that brewers should keep any sugar that they have in sugar store. It is not to be in any other part of the brewery. There have been one or two occasions upon which we have served the notice upon the brewer to deliver his invoices, but none of recent years, and I think only two or three times since the Act was passed. It is only where we have not been satisfied with the condition of things, and where there has been some suspicion that a brewer has been using sugar improperly. As regards adulteration or additions to beer, I may perhaps point out that that refers to finished beer. In the manufacture of the beer the law practically permits the use of any material capable of being used in brewing. All that we have to do is to value the material relatively to malt or sugar. The Act was passed in 1885, I believe, because it was found that we required greater powers in order to prevent the addition of sugar or sugar solutions to beer after it was finished.

Adulterations of
finishes

6556. That is what is called priming?—Yes, in order to regulate that. Our policy has been not to object to additions that do not affect the gravity of the beer, or such as the apparent gravity of the beer. Provided the substances that have been submitted to us do not appear to alter the gravity of the beer after it is finished, or to alter the apparent gravity of the beer, we should not object to them provided they were wholesome. If there was anything submitted to us that was obviously unwholesome we should object to that, but in no instance has any substance been submitted to us for addition to beer that we had to object to on the ground of its being unwholesome. Additions are made for three purposes. First, for fining or clarifying the beer, for that isinglass or some other similar substance is commonly used. Then there is the priming, which is intended to give a certain life and briskness to the beer before it goes out. Mainly sugar solution is used for that, if not entirely. We have had one or two instances of things in the way of frothing powders to give a head to beer, but most of those have been refused. I believe Bradley's powder is allowed, otherwise we have refused several.

6557. Refused on what ground?—For instance, last year we had a case before us of some stuff called stoutine. That was intended to give a head to beer, but in the advertisement it also claimed that it practically enabled the brewer to diminish his gravity by four degrees.

6558. What does that mean in relation to alcoholic strength?—That would not necessarily affect the alcoholic strength, but it would affect the amount of duty chargeable.

6559. The duty is charged according to the gravity?—The original gravity of the worts before fermentation.

6560. Is there any taking of specific gravity of the finished beer?—No, unless in the case of any suspicion that the gravity has been increased. Supposing sugar were added after we had taken the gravity, and the dip of wort, then we might test the finished beer, but in the ordinary course of things we merely test the original gravity of the wort before fermentation, and assess the duty on that, and do not again test the beer.

6561. Adding sugar as priming would add to the specific gravity of the finished beer?—Yes, to a small charge, and of course duty is charged upon so much priming sugar as they put into the priming.

6562. Duty is charged on the priming?—Yes.

6563. Is the charge on the same principle as if the priming ultimately became fermented?—It is charged on the same principle as if it had been put into the original wort.

H. W. 6564. So that priming is charged as a fermentable
material?—Yes.

y 1901. 6565. And it does add to the alcoholic strength after
the beer has been kept for a little time?—I suppose it
would very slightly.

6566. It gives some degree of briskness to the beer,
and in so doing must add to the alcohol?—Yes.

6567. (*Professor Thorpe.*) That is indicated by a term
frequently used here, "the after-fermentation." There
is always an after-fermentation, and that of course acts
upon the added sugar?—Yes.

6568. (*Chairman.*) Would you kindly give us the
titles and dates of the Acts?—The Act of 1830 is the Act
43 and 44 Victoria, Chapter 20; 48 and 49 is 1885; 51
and 52 is 1888. Just to finish on that point of the addi-
tions to beer, there is one other object in the additions,
and that is what they call preservatives. Certain things
have been sanctioned for that purpose, such as bisul-
phate of lime, sulphate of lime, salicylic acid, and car-
bonate of potash. I think that represents practically
the whole of them.

6569. I suppose the effect of these substances is to
keep the beer from going sour?—Yes.

6570. Is salicylic acid admitted to be useful in that
respect?—I believe brewers consider it is so. I am
not competent to speak on that, I am not a chemist.

6571. Is that prohibited?—No, it is allowed.

6572. The question of the health of the drinker of
the beer in respect of salicylic acid has not appeared?
—No.

6573. None of the other substances that you men-
tioned are considered as adulterations?—No, because
they have been allowed by the Commissioners of In-
land Revenue.

6574. What is adulteration in the sense in which the
word is used in the Act?—I suppose any addition really
would be adulteration, but it ceases to be adulteration
if the substance added is approved by the Commis-
sioners. That I take to be the state of the law.

6575. We were told by one of the public analysts
who gave evidence that he would consider glucose as
an adulteration in golden syrup. That does not come
under the Inland Revenue, I presume?—No.

6576. The question what was adulteration and what
defines adulteration necessarily arises when you meet
with the word in the Act?—We should consider the
addition of water, for instance, an adulteration. It
is dilution, but I think it might fall within the legal
meaning of adulteration.

6577. The addition of water to whisky by a publican,
is that adulteration of the whisky?—I think that might
perhaps be adulteration within the meaning of the
section.

6578. And the publican would be liable to be fined
for getting money under false pretences?—A publican
is prohibited under the Sale of Food and Drugs Act
from selling whisky below a certain strength, or any
spirit. Whisky 25 per cent. under proof is the mini-
mum at which a publican may sell. He could put
water to that extent.

6579. But if he puts in more water he is cheating?—
He could be prosecuted under the Sale of Food and
Drugs Act.

6580. But not in virtue of the adulteration being
deleterious to health?—No, as being a fraud upon the
purchaser.

6581. Not letting the buyer have his money's worth?
—Yes.

6582. (*Professor Thorpe.*) I think also it is not in
that case the Revenue who prosecutes him, but the
public authority?—It is. We have never taken action
I am told on Revenue ground.

6583. (*Chairman.*) With regard to the prohibition of
substances under the Act of 1888, that is for two pur-
poses; (1) to secure the Revenue, and (2) to protect
the public against noxious ingredients?—Yes.

6584. Can you suggest any really practical method
of utilising that provision of the Act of 1888 so far as
public health is concerned? Other authorities must
be responsible also, but can you suggest any useful
mode of taking advantage of that provision of the Act
by the Board of Inland Revenue?—We considered care-
fully whether in connection with this particular
epidemic and this particular incident of the arsenical
poisoning of beer we could usefully exercise the powers

that are given us by the Act of 1888, and we came, on
the whole, to the conclusion that it would be extremely
difficult. In the first place, the substances that have
produced the epidemic were not noxious or detrimental
in their own nature. It was owing to the accidental
introduction into them of a deleterious substance.

6585. But one of the substances was arsenic?—That
is so; and, of course, we could prohibit the use of
arsenic. But it would be almost absurd to prohibit the
use of arsenic. The question is, could we have pro-
hibited the use of glucose or invert sugar containing
arsenic? That was the point we considered. As a
matter of law we are advised that it would be con-
ceivably possible, but as a matter of practice it seemed
to us that it would be very difficult to enforce the pro-
hibition, for the reason that no Excise officers could
possibly state whether or not the article was or was
not contaminated with arsenic. It would have in-
volved sampling every consignment of invert sugar
or glucose that was received at a brewery, sending
it up to London to be tested, and then reporting
whether it was free or not. To be of practical use it
would have been desirable that a brewer should not
have been allowed to use it until it had been certified
as free, and we came to the conclusion that that
section would not really meet this particular case.
A suggestion was made which I think is a practical
one and might be useful, and in which we could very
well assist, that the law should provide that no brewer
should receive into his brewery any of the substances
without a certificate that they had been submitted to
a particular test, the test being one that should be
prescribed by a suitable authority, either by the
Government Laboratory or other authority, and that
then we could aid in seeing that that provision of the
law was enforced. Under this power we have in the
Act of 1885, we could see the invoices and certificates
and occasionally test the samples to see that the cer-
tificates were really valid.

6586. But suppose you put the question of deleterious-
ness to health practically on the same footing as the
question of the revenue. Of course, it would be im-
possible to send samples of every consignment to the
London Central Laboratory as you have explained, but
that is not done either for the protection of revenue.
You do not send samples of every substance to the
Government Laboratory in London for the sake of pro-
tecting the revenue, but it is only in a case where your
inspectors are not satisfied, and think that some of the
substances used must be tested?—Yes. A certain num-
ber are dealt with at local laboratories, but the majority
are sent to London. We deal with some samples at the
local chemical stations, but we have not a great many
of them, and the majority are sent to London. My
point is that if we were testing in matters of health it
would mean a far larger number of samples than are
necessary for the purpose of revenue. It would never be
safe for us to assume that things were going right.

6587. A small proportion of all the material comes
to London and is tested for the sake of the revenue?—
Yes.

6588. But not hitherto for the protection against dele-
terious ingredients?—No.

6589. Would there be any real difficulty in ordering
that every sample that is sent for test to the Central
Laboratory in respect to duty should also be tested in
respect to healthiness. That would add somewhat to
the work of the laboratory, but it would not be an
enormous expense to test specimens that you have
already in hand and are testing partially, simply making
the test somewhat more comprehensive and including
a test against arsenic, which we now know to be a sub-
stance that beer is liable to contain?—If it was limited
to testing for one particular poison like arsenic I
imagine that would not very seriously affect us. But
then comes the question, can you limit it to one thing?
Nobody suspected the presence of arsenic a year ago,
and a year hence something else may be found.

6590. Of course it would be impossible to exact a
full chemical analysis of every product, but it would not
add greatly to the labour at present incurred to test
for a substance we now know to have entered consider-
ably and injuriously into the beer on which the duty is
paid?—I am not really qualified to speak on that, and I
should suggest that the Commission might perhaps take
evidence on that from Dr. Thorpe, the Principal of the
Laboratory. He could tell you at once.

6591. We hope to do that and have his advice upon
the matter, but in the meantime we may take it you do
not see any constitutional or legal difficulty in extend-

Sir H. W.
Primrose,
3 May 1901.

Reasons for
not prohibit-
ing arsenical
sugars under
1888 Act.

Sir H. W.
Primrose.
3 May 1901

ing the tests that are made so as to include some particular named substance or substances which might be injurious?—It would add to the work, but I do not know that it would add to such a degree as to be very serious. That Dr. Thorpe will explain better than I can.

6592. But in the meantime you do not consider yourself that fresh legislation giving additional powers for the purpose of carrying out the provision of 1883 against deleterious substances is wanted in respect of the Board of Inland Revenue?—They are very great powers under the Act of 1883.

6593. The Board of Inland Revenue has sufficient power in that respect?—Yes. Supposing in connection with this recent epidemic if it had been proved that arsenic had almost invariably been present to a dangerous extent in any given substances, glucose or invert sugar, it would have been quite within our power under that section to prohibit that article absolutely. The difficulty we found was that we could only prohibit a thing conditionally, that is to say on the condition that it was in a certain state and contained arsenic.

6594. It would be right that you should be cognisant of a certificate given that the substance does not contain arsenic?—Yes, that would be quite a simple matter.

6595. And occasionally at comparatively rare instances to verify at your own laboratory the correctness of the certificate given?—Yes.

6596. (Sir William Church.) You would, under existing powers, have the power of taking a sample of invert sugar if you like?—Yes; we have complete power to take samples of anything.

Action of
Board of In-
land
Revenue
with regard
to epidemic.

6597. (Chairman.) In respect to the action of the Board of Inland Revenue in reference to the recent epidemic, what have you to say?—I have explained that we did consider whether we could take action under the 1883 Act, and eventually we decided that we had better await the result of the enquiries. We were cognisant of what was being done. For instance I communicated with the Local Government Board to ascertain what steps they were going to take in connection with the epidemic and I daresay the Commission have had before them a circular which was issued on the 11th December to County Councils and so on, drawing their attention to the danger and advising that they should take samples of beer; and we were also aware of the circulars that were being sent out by the brewers' societies, and of the enquiry which was being conducted in Manchester itself. So that for the moment it appeared to us that nothing we could do would add to the precautionary measures that were being taken in other quarters, and that so far as any definite action was concerned it was better to await the result of the enquiries.

6598. The Board took so far definite action as to repay the duty on contaminated beer which was on the brewery premises, and which was destroyed?—Yes.

6599. Is duty repaid on beer that has left brewery premises for export?—On all beer exported the duty is repaid.

6600. (Sir William Hart Dyke.) You say that you think the powers you now possess for the protection of public health might be more utilised if Parliament so provided. I suppose you mean to suggest that if on going further into this question it should be necessary that legislation should take place, you think it would be advisable?—I think within limits.

Excise super-
intendence
might be
utilised for
protection of
public
health,

6601. You suggest that it might become possible at all events that legislation might be necessary?—The view I take rather is this, that the Excise officers are present in breweries to a certain extent, in some breweries constantly, others they occasionally visit. Therefore you have a body of men who might be utilised for purposes other than the purposes of the Revenue, for such a purpose as the protection of public health, for instance. But speaking as head of the Inland Revenue, I should be reluctant to see more than a limited amount of additional duty of that kind thrown upon our officers, because a man's primary business is the Revenue part of the thing. If his attention is to be too much distracted it would be difficult for an officer to attend fully to his revenue business. It is a question of degree. I quite see, having our officers there, they might be made useful for certain purposes, but within limits, otherwise there is a great risk that officers being overloaded with duties of a different character and different kind may not attend as fully as they otherwise would do to the primary business of the Revenue.

but only to a
limited
degree,

6602. In fact, it would interfere with the main respon-

sibility of your Department, which is the protection of the Revenue?—Yes, if carried too far.

Sir H.
Primrose
3 May

6603. You do not think it would be a satisfactory state of things to leave the protection of the public health precisely where it is to-day after such a severe epidemic as has recently taken place with great loss of life?—I think it is clearly desirable such a thing should be prevented.

6604. Do you think the whole responsibility for the protection of public health should be placed somewhere under Government?—No, I do not think I should go as far as that. I think I should be inclined to move rather in the direction of strengthening the local authorities.

6605. That would be bringing the matter under the superintendence of the Local Government Board, would it not?—No doubt.

6606. And do you think it satisfactory altogether that there should be two departments responsible for the public health—the Local Government Board and the Inland Revenue?—I think the primary responsibilities of protecting the public health should lie with the local authorities.

6607. And under the Local Government Board?—Yes; and they would be controlled by the Local Government Board, who are better able to do it than we are. What we could do would be to assist in the matter.

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beer
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6608. You deal, do you not, with all the ingredients that go into beer?—Yes, everything.

6609. But with regard to dealing with the finished article that would come under the Sale of Food and Drugs Act?—Yes, when on sale.

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D. Act

6610. Once on the market it would come under the Sale of Food and Drugs Act?—Yes.

6611. And therefore the finished article would come under the Local Government Board?—Yes.

6612. That is, I suppose, what you mean, that any intervention on the part of the Inland Revenue should take place within narrow and well-defined limits?—I think so.

6613. With regard to this late severe epidemic you suggest that the traders should be made primarily responsible?—Yes, the suggestion was made originally by Dr. Thorpe, and it seems to me to be the one which would be the most effective and the most simple, that they should not be allowed to receive these artificially prepared materials, and possibly it ought to extend even to malt, but that I really do not know. I have seen in the papers that malt has been found also to be contaminated. But certainly as regards the artificially prepared materials I think it would be quite reasonable to require that they should demand from the manufacturer preparing them a certificate, and I think a certificate ought not to be left vague, but ought to be prescribed by proper authority.

Brewers
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6614. Do you not also think it well that brewers should be compelled, besides the receipt of the certificate, to test for themselves each ingredient on purchase?—It would be very difficult. All the big breweries do so. I think to impose by law an obligation on every brewer to test would come very hard on the small brewers.

6615. In respect of all large businesses, this would be easy, because they have their own analyst and laboratory?—Yes; but the small public-house brewer, or people who brew 50 or 60 barrels a year would have no means really of testing things for themselves.

6616. Would the use of glucose and sugar be as common amongst the small brewers?—No, I do not think it is.

6617. In the majority of these cases, would it not be malt beer?—Yes; the very small brewers, I believe, do not use sugar, or use it to a very small extent.

6618. You believe it would be difficult to make the test compulsory by the brewer on the receipt of the ingredients?—I think it would; there are a good many moderate-size breweries where they have not the staff necessary or the scientific knowledge.

6619. You mention a question of priming, for which Limit purpose you say sugar solution is used. You indicated priming that only a certain quantity is allowed for the purpose. How can you tell us what percentage per gallon of this sugar solution is used?—One and a half per cent. by quantity; that is to say, in a 36 gallon cask of beer half a gallon, roughly, might be added.

H. W. 6620. (Mr. Cosmo Benson.) It might be useful to get on the notes the amount of beer duty, roughly?—Last year, up to the 31st March, it was £13,500,000; but that was the Exchequer Revenue. You must add 3d. per barrel to that.

6621. Roughly, about 14 millions, I think?—Yes, roughly, about 14 millions. You would have to add to the £13,500,000 about one-thirtieth.

6622. Can you give an idea, roughly, about the cost of collection of it?—I am afraid that would be rather difficult. We reckon, if I remember aright, the total cost of collection of all our revenues.

6623. I am asking because I wanted to know whether the suggestion you have made as regards the certificates being given by traders being checked by the Inland Revenue would add much to the cost of collection?—No, nothing at all I should say. It would not add to the cost of our Excise officers, but it might add a little to the work of the laboratory, but I hardly think enough to be appreciable.

6624. But if the whole burden was put upon you of seeing that every ingredient that entered into the brewery was free from arsenic or other poison, it would add considerably to the cost of collection?—Undoubtedly.

6625. With regard to the question of giving drawback, you give a rebate, I understand, on arsenical beers in breweries?—Yes.

6626. That have never left the premises?—Yes.

6627. On beers that had left the premises, and gone into a public-house you refuse?—Yes. We had a certain number of applications, but we refused on the ground that the law was against us.

6628. Does the law allow you to give a rebate on beer brewed? I know of no provision myself?—Yes, section 18 of the Inland Revenue Act of 1880. It says this: "When any materials upon which a charge of duty has been made, or any worts or beer, shall be destroyed by accidental fire, or other unavoidable cause, while the same are on the entered premises of a brewer, the Commissioners shall, on proof of such loss to their satisfaction, remit or repay the duty charged or paid." That is the whole of our power, really. It limits it very strictly to "while the same are on the entered premises of the brewer."

6629. Should you have any objection to undertaking, by further powers, to give a rebate on beer that was sent out, and proved unfit for consumption, and came back to the brewer?—It might cause a certain amount of trouble. I think, as a matter of general principle, it would really be desirable if possible, if the practical difficulties were not too great.

6630. Leaving it to the discretion of the Board of Inland Revenue?—Yes. The general principle is, that what does not go into consumption ought not to pay duty. Therefore, if we can be satisfied that beer did not go into consumption there would be a great deal to be said on general principles for allowing the duty. It would be a great trouble.

6631. Parliament would have to give a considerable discretion to the Board of Inland Revenue as to discrimination in different cases?—Yes.

6632. But it might make it permissive?—Yes. One difficulty, I think, could be got over. Of course, there is a certain amount of beer brewed by private brewers, which does not pay duty, but I think it ought to be possible to get over that.

6633. What struck me was, that if there had been some bait in the way of a drawback the beer in the retailers' cellars would have been returned quicker to the brewers than it was, and that it became dangerous to public health lying about in the publicans' cellars, where it might have been drawn?—Yes, it would have been an additional inducement to people. On the other hand, the duty, I suppose, does not represent more than one quarter of what the loss would be, so that it would not be decisive. It is not like a duty of spirits, for instance.

6634. Generally speaking, you would not object to further powers for giving the rebates on beer unfit for consumption?—I feel myself that it is a point that is worth considering, and would really demand rather sympathetic consideration from the Board of Inland Revenue, if it could be arranged.

6635. (Chairman.) Did I understand you rightly, that some beer for export has had the duty remitted? Did I understand it had left the brewers' and that the duty was remitted?—That is so because the law provides for

drawback on all beer exported. Whether there was arsenic in it or not would not make any difference. Anybody who exports beer gets the duty back.

6636. But suppose arsenical beer was actually exported, you would not give the drawback on that, if exported and sold abroad?—Yes, we should give the drawback on that. It gets the drawback, as a matter of course, when it leaves the country.

6637. It all gets the drawback, irrespective of quality?—Yes.

6638. In respect to beer returned from publicans to the brewer—suppose the beer goes bad. It becomes sour, and the publican finds he has to return it to the brewer, is the drawback given there?—Not at present.

6639. It does sometimes happen, I suppose, that a number of barrels of beer are found bad?—Yes.

6640. And the publican returns them to the brewer, and they are destroyed?—They are either destroyed or not—I believe, sometimes not.

6641. Sometimes they are doctored?—Yes.

6642. If they are returned, could there be a proper claim on you for the return of the duty?—Not as the law stands now.

6643. And you would possibly approve of some change in that respect?—It is a point that I think well deserves consideration. I should be glad to consider it. It would be a matter on which the Treasury would have to have their say; but from the point of view of our Department I feel there is a good deal to be said for it.

6644. It would not be merely to consider whether the beer was injurious by containing arsenic, but whether it was injurious from having become sour, or poisoned in some way?—Yes.

6645. (Sir William Church.) If the beer goes bad under those circumstances, it is proved of bad manufacture?—Yes.

6646. He has manufactured an inferior article, and, therefore, he should very properly lose over it?—I fancy beer may go bad without really any blame attaching to the brewer under certain circumstances.

6647. (Chairman.) It would be necessary to judge whether the badness was the fault of the brewer or not?—I think it would. Some words similar to those in the existing law—unavoidable accident, or something of that kind.

6648. (Mr. Cosmo Benson.) I think I may take it it was the wish of the Board of Inland Revenue to give the rebate on the beers found to be contaminated with arsenic, so long as it had not left the brewery?—Yes.

6649. We have a letter sent to the Commission to say that in one instance beer had been removed from one brewery to another, and that on that account it was refused?—I do not remember the case. No doubt it would be rightly refused under those words, "While the same are on the entered premises of a brewer."

6650. His argument is that he moved it from one end of the premises to another part of his entered premises, but the fact of having taken the beer along the street outside the premises lost him the chance of rebate?—I should be very glad to see the letter.

6651. (Dr. Whitelegge.) I think you told us that, after the Manchester epidemic, the Board proceeded to cause samples of wort and beer to be tested?—Yes; mainly in connection with the claims for repayment, and to a certain extent in other ways. But the samples were mainly tested for arsenic, and were those of beer which were said to be contaminated, and which they wished to destroy.

6652. (Professor Thorpe.) No worts were taken in connection with this inquiry?—No. There is this to be said, supposing we had tested for arsenic and we had found arsenic, I do not know that we could have done anything more than warned the brewers that it was there, and that they had better be careful.

6653. (Sir William Hart-Dyke.) You would have given information to the Local Government Board at once, probably?—Yes.

6654. (Dr. Whitelegge.) The samples taken were beer, but not wort, or glucose, or malt?—No malt, certainly, nor glucose.

6655. The action does not imply any change in the view of the Commissioners as to their powers to deal with deleterious substances. It was as a Revenue question it was undertaken, was it not?—Yes.

Sir H. W. Primrose,
3 May 1901.

No rebate allowed on unsound beer returned to brewer and destroyed.

Beer tested for arsenic where rebate claimed.

but not brewing ingredients.

Sir H. W.
Primrose,
3 May 1901.

Only beers
on which re-
bate claimed
were tested.

Local
authorities
might be
given powers
to take sam-
ples at
breweries.

Inaccurate
guarantee of
purity of
brewing in-
gredients
should
involve
penalty.

6656. I suppose some of the samples of beer were found to contain arsenic?—Nearly all of those that were submitted for destruction. There were cases, or certainly one case, in which a considerable quantity of beer was destroyed, and we did not discover any arsenic in it. Their chemist had discovered arsenic, but the Government laboratory did not.

6657. Where arsenic was found in a large quantity, were the local authorities informed?—No; because, as I explained, the examination that we made was in respect to the beers which were condemned by the brewers themselves.

6658. (Professor Thorpe.) They were all beers lodged for rebate in consequence of containing arsenic, or of being brewed from materials which were known to contain arsenic?—Yes.

6659. (Dr. Whitledge.) The enquiry did not proceed beyond samples taken from breweries by reason of being known to contain arsenic, and proposed for destruction and rebate?—Yes.

6660. You mentioned the circular issued by the Local Government Board to the local authorities?—Yes.

6661. That was issued by the Local Government Board on the advice of the Board of Inland Revenue?—No; I should not like to say that.

6662. At all events, it was issued by the Local Government Board?—Yes.

6663. Has the Board of Inland Revenue ever issued any instructions in connection with the arsenic in beer?—No.

6664. You suggested, I think, that the local authorities ought to be primarily responsible for dealing with the sources of danger to public health?—Yes.

6665. You are thinking of the finished beer?—Yes.

6666. And the finished beer in the hands of the retailers?—Yes.

6667. Were you contemplating further powers for the local authorities to deal with the beer before it reaches the retailers?—I see no reason why they should not be allowed to have samples at any stage of manufacture.

6668. Irrespective of locality?—Yes; within their own area. The local authority should have power, if it was thought necessary, to watch over the manufacture of beer, as well as over the distribution of it.

6669. You are aware, of course, that no such power exists now?—I know.

6670. Would you extend that suggestion to the manufacture of beer ingredients?—That is a point I do not feel I am competent to speak about. It is quite conceivable that it might be a desirable thing to do.

6671. You suggested further that the brewer should be required to obtain a certificate of purity of the ingredients, as a measure of protection?—I think that would be a good thing.

6672. What would happen if such a certificate were given inaccurately? What machinery would there be for enforcing the accuracy of such a certificate?—None, as things are now. I am contemplating legislation.

6673. But assuming there was legislation requiring a certificate, and, as you further suggest, a certificate in prescribed terms, have you thought what machinery ought to be brought into operation, assuming an inaccurate certificate to be given?—I assume that penalties would be imposed. We did sketch out the sort of provisions that might be put into the law. No doubt there would have to be heavy penalties attached to the giver of the certificate.

6674. I understood you to say it would not be convenient, at all events to the Board of Inland Revenue, to undertake any extensive duty of analysis of samples, and I think you further told us that the brewer ought not to be compelled to make analysis. The local authorities, as the matter stands at present, would not be on the brewers' premises, and some sort of provision would seem to be necessary for action in case of the certificate being wrong?—No doubt. What might be done, and I think perhaps would not be a bad thing to do, would be at the same time to give powers of inspection of the manufactories where these glucoses and so on are made. There are not a great many of them. They would be the people who give the certificate, and therefore it might be well to place them under some sort of observation, giving power to enter their premises.

6675. If the local authorities had power to enter on the brewers' premises, would they not have the great

advantage which at present the Board of Inland Revenue officers have, and the local authority's officers have not, of testing from a large bulk?—Yes.

6676. If samples are taken from the brewery, is there not the great advantage that the samples can be taken from a large bulk?—Yes.

6677. As matters stand, and without the local authority having power of entry to the brewery, or manufactory, are we not placed at a great disadvantage, first by not being able to test in bulk, and secondly, in the case of beer, by the very large bulk of the individual sample they have to take from the retailer?—No doubt that would be so.

6678. You said it would be a very difficult task for the Board of Inland Revenue to undertake extensive sampling for the protection of public health, but it would be possible if their duty were limited to one item such as arsenic?—Yes.

6679. Of course the same difficulty of volume of work would apply equally if that were done by the local authorities?—No doubt.

6680. What is attempted under the Sale of Food and Drugs Act is not to cover the whole ground, but to test by infrequent sampling, probably not one in a thousand of any given food substances?—That is so.

6681. So that as matters stand, if it is difficult for the Board of Inland Revenue to contemplate an extensive sampling of ingredients in bulk or food in bulk, it is almost impossible for the local authorities?—I think it would be much less difficult for the local authority. They would only have to deal with the breweries within their own area, and they would not have to deal with such an immense number of samples as we should have.

6682. You mention certain substances as having been approved by the Board of Inland Revenue, and certain others having been observed. I did not quite understand your answer to the Chairman to be final as to the consideration of health in that approval or refusal. Have considerations of health entered into the decision?—Yes, to this extent, that if any of those substances had been thought to be dangerous to health in the quantities that they would be used, we could have refused. That I have no doubt about.

6683. Under the powers of the Act of 1893?—No; rather under the Act of 1895, because these are things that are added. They come under this: "The brewer is prohibited from adding any matter or thing to beer except finings for the purpose of clarification or other matters or things sanctioned by the Commissioners of the Inland Revenue." When they want to add to finished beer something for the purpose of priming or preserving, they have to submit the substances they propose to use to us, to know if we should object. We should object strongly. I think, to anything which could be regarded as undoubtedly dangerous to health.

6684. Then the fact that you do take public health considerations into account in a decision under that head does not depend in any way on the reading of this doubtful point in the 1893 Act?—No; that is quite independent of the 1893 Act.

6685. Has your view of the 1893 Act in that respect always been the same?—Always.

6686. I think you were a member of the Committee on Beer Materials?—I was.

6687. In the report of the Committee there is one paragraph: "Moreover the Treasury are empowered to prohibit the use in the manufacture of beer of any substances or liquor of a noxious or detrimental nature. It is the duty of the chemist employed in the Government laboratory to keep a vigilant watch in this respect over all beer brewed and sold, and they have ample opportunities for so doing; but it has never in practice been found necessary for them to prohibit the use of any material by reason of its detrimental nature, the prohibition of saccharine in 1893 having been due solely to reasons affecting revenue." In that paragraph are we to understand that the "noxious or detrimental" are held to apply mainly to revenue considerations?—I think not. I think the intention was to indicate that if in the course of their examination of material the Board of Inland Revenue had come across things clearly noxious or detrimental in their nature, they had opportunities of observing them, and could have prohibited them. I think it is intended to reassure the public mind as to their not being noxious or detrimental substances used.

Sir W.
Primrose
3 May 1901
Whether
control of
brewing
ingredients
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Board of
land
Revenue

Addition
injurious
substances
finished
would be
objected
by Board
Inland
Revenue

Beer
Materials
Committee
on contents
Board of
land
Revenue

H. W. 6688. Although an examination has been made, none have ever been found?—Yes.

6689. I see Mr. Bannister, in his report to that Committee, says:—"The samples of beer and wort that came to us were not examined except for the original gravity. The samples of beer and wort that came up to us are divided into two classes, some for the determination of original gravity just for the purpose of checking brewers' returns, but others are actually examined for the purpose of seeing whether they contain any deleterious ingredient. That work is constantly going on." That would apply, then, to the wholesomeness and absence of poisonous ingredients?—Yes. I do not understand in our laboratory that we have made exhaustive analyses with the view of looking for such a thing as arsenic, for instance. I am not a chemist myself, but I understand in analysing you do not find a thing unless you look for it, and I do not believe the laboratory has assiduously looked for such elements as arsenic. But if there had been anything very serious there would be an opportunity to find it. I think that is all Mr. Bannister meant.

6690. Having found that arsenic was present in beer, and in the glucose from which some of that beer was made, the difficulty that the Board of Inland Revenue felt was that the arsenic was not a substance added as such, but was merely an ingredient of the beer ingredient?—It was a pure accident. In speaking as regards our action last December and January, we know a great deal more about the thing now than we did then. Even then it appeared more or less an accident. We knew it was not distributed over the whole country, but limited to a certain part of the country, and now it appears it was limited to the product of one factory.

6691. (Professor Thorpe.) I think I should like to bring out one or two points which I daresay Sir Henry Primrose would wish to make clear to the Commission. You told us that you thought it was no necessary duty of the Excise authorities, because they took a tax off what was a food or drink, that they should necessarily be responsible for its quality or purity?—That is my view.

6692. There is no logical necessity imposed upon it by virtue of that accident?—No.

6693. It is a fact, is it not, that the Excise takes a revenue off a number of proprietary articles, as they are called?—Yes; patent medicines.

6694. But it undertakes no responsibility as to the character of those things?—Certainly not.

6695. The Revenue authorities, speaking generally, do handle, for fiscal purposes, considerable quantities of food, the Customs for example?—Yes.

6696. They take duty off such things as dried fruits, chocolate, liquors, wines, but in levying the duty on those things they are not in any way answerable, nor do they take any responsibility for their quality?—That is so.

6697. (Dr. Whitelegge.) Nor, I presume, is there any paragraph like this we have been discussing in the 1888 Act, applicable to patent medicines or other substances?—The 1888 Act would apply to the patent medicines. It does not specially mention beer. What it really says is, "on any article liable to a duty of

Excise," therefore it would include the patent medicines.

6698. (Professor Thorpe.) But with respect to the intention of the 1888 Act, the difficulty we had in considering the application of it, I believe, must be that the substance which was to be prohibited was in its very essence and in its very nature detrimental—that it was not accidental detrimental contamination, but it was like *coccus indicus*, or grains of paradise, or quassia, that is things which were of their essence and nature detrimental?—That is the view which has always been acted upon, and held at Somerset House.

6699. With respect to the question which Mr. Cosmo Bonser put to you, as to the willingness of the Excise authorities to consider favourably an application for the return from the publican of the spoilt beer or from the traders, there is in the Customs procedure a somewhat analogous case as regards tobacco which is not marketable—offal tobacco, for example?—Yes.

6700. There the Customs will receive and repay the duty on that on the ground that it is not of any commercial importance?—Yes.

6701. And this idea that possibly the Excise might do something similar in the case of unusable beer?—Yes, that is a very parallel case.

6702. In the answer you gave to Dr. Whitelegge respecting the action which we might take in superintending, or even that the local authorities might take in superintending, the output of the glucose and invert works, there would be a difficulty, would there not, that a considerable quantity of similar material is imported?—Yes.

6703. Therefore the character of that material could only be guaranteed on the certificate?—That is so.

6704. In the case of imported glucose, the local authority or the Excise would have no means whatever of controlling the manufacture of these things?—No, that would have to be done on the certificate.

6705. It would rather lead to complications to have two methods of supervising the genuineness or character of the same product?—Yes; I think it would.

6706. (Sir William Hart Dyke.) With regard to administration, may we gather that with regard to guaranteeing the public against a catastrophe such as lately happened, you could easily collect certificates of purity, if such were demanded? It would not bring any extra stress of work on your department to do that?—No, I think it would be quite simple.

6707. But if we endeavoured to press you further, and if the guarantee of purity by test is to be demanded of each ingredient entering the brewery, to place this on your Department would be beyond the scope of your duties, and cause a dislocation of the work of your Department?—That is my view.

6708. And, therefore, whether Parliamentary action be thought necessary or not, in any case you think the onus of protecting the public should be thrown on the Local Government Board?—I think that would be consistent. They are already responsible for non-exciseable food and drinks, and I do not see why there should be any great difference made as regards the exciseable.

Sir H. W. Primrose.
3 May 1901.

Question of rebate on unsound beer.

Manufacture of imported glucose cannot be supervised.

Primary responsibility for purity of beer and food should rest with Local Government Board.

Dr. JAMES CAMPBELL BROWN, called; and Examined.

J. C. Brown.

6709. (Chairman.) You are Professor of Chemistry in University College, Liverpool, and Victoria University, and Head of the County and City Laboratory, Liverpool, and, in the first place, you have some results of analysis of various substances for arsenic to give us?—Yes.

The following statistics cover a period of two months from the 26th November, 1900, to 31st January, 1901. They include samples received from inspectors from the Administrative County of Lancaster, the City of Liverpool, and the Boroughs of Bootle, Blackburn, Blackpool, Barrow, and Preston:—

Beer, 890 Samples.

1 contained 1.5 grain of white arsenic per gallon.

1	"	1.35	"	"	"	"
1	"	.8	"	"	"	"
4	"	.75	"	"	"	"
3	"	.66	"	"	"	"
1	"	.6	"	"	"	"

4 contained .5 grain of white arsenic per gallon

1	"	.3	"	"	"	"
1	"	.28	"	"	"	"
2	"	.25	"	"	"	"
4	"	.2	"	"	"	"
4	"	.16	"	"	"	"
9	"	.14	"	"	"	"
5	"	.11	"	"	"	"
3	"	.1	"	"	"	"
5	"	.07 to .084	"	"	"	"
2	"	.03 to .06	"	"	"	"
1	sample made from malt dried with best anthracite and afterwards once cleaned, contained .014 grain, was the largest quantity passed on the preliminary qualitative analysis.					

52 accurately determined.

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Add to these:—

- 16 additional samples approximately estimated to contain between one-half grain and one grain per gallon.
- 23 additional samples approximately estimated to contain between one-fifth to one-half grain per gallon.
- 33 additional samples approximately estimated to contain between one-tenth to one-fifth grain per gallon.
- 26 additional samples approximately estimated to contain between one-twentieth to one-tenth grain per gallon.
- 21 distinct traces, but under one-twentieth grain per gallon.
- 116 detectable but negligible traces.
- 593 none detectable in half-a-pint.

Total 890 samples of beer.

The larger quantities were all before 6th December.)

During February 1901, a total of 133 additional samples of beer were analysed:—

- 7 contained about one-tenth grain per gallon, or more than one-twentieth grain per gallon.
- 14 contained very distinct traces of arsenic.

[All the above 21 samples were from the County area.]

- 112 contained such very minute traces that they were considered genuine. Of these genuine samples

68	were from County area.
34	" " City of Liverpool.
10	" " small Boroughs.
112	

in brewing
sugars.

Samples of brewing and other sugars from various sources.

Brewing sugars:—

- 1 black glucose contained above .131% = over 9 grains per lb.
- 1 glucose contained .115 % arsenic = 8. grains per lb.
- 1 " " .096 " " 6.72 "
- 3 (1 glucose, 2 inverta) contained .062 % arsenic = 4.34 grs. per lb.
- 1 glucose contained .037 % arsenic = 2.6 grs. per lb.
- 1 " " .031 " " 2.17 "
- 1 " " .028 " " 2 "
- 2 " " .027 " " 1.9 "
- 1 " " .025 " " 1.75 "
- 1 " " .022 " " 1.54 "
- 2 " " .019 " " 1.33 "
- 2 " " .018 " " 1.25 "
- 3 " " from .015 to .01 % arsenic = 1 to .75 grs. per lb.
- 1 " " .008 % arsenic = .5 grs. per lb.
- 1 (not Bostock's) contained .004 % arsenic = .28 grs. per lb.
- 1 glucose contained .003 % arsenic = .2 grs per lb.
- 2 (not Bostock's) contained .0025 % arsenic = .175 grs. per lb.
- 25 in all.
- 37 others contained a serious quantity of arsenic, but the quantities were not determined.
- 2 others contained minute traces.

Total 64 contained arsenic.

70 " none.

" 134 analysed.

Other saccharine substances:—

195 samples of Jam	During 3 months, 1 December 1900 to 1 March 1901.
Sweetmeats	
Syrup	
Cane Sugar, &c.	

From the County	86
" " City	75
" Blackburn	5
" Blackpool	13
" Barrow	8
" Bootle	8
	195

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Malt.

Forty-eight samples of malt from private sources in malt, have been analysed during three months. All except six contained arsenic in quantities varying from a minute trace up to a quarter of a grain per lb.

The six samples of malt free from arsenic had all been brushed after they came from the kiln.

Six additional samples of malt have been analysed in March. These show a great improvement. The largest quantity is .04, or 1.25th grain per lb., and two contain only the minutest trace—practically nothing.

Yeast.

Nineteen samples of yeast were analysed, all of which in yeast, (except one) contained a distinct trace of arsenic. The quantity in each was too small to be determined, but the average quantity in the 18 samples was found to be .015, or 1.67th grain per lb. They included British and foreign pressed yeast and balm from a brewery.

Latterly 14 additional samples of yeast have been analysed, all of which except two contained similar quantities of arsenic.

Sulphuric Acid.

I have analysed six samples of brown oil of vitriol in Niebo obtained from Messrs. Bostocks. sulphuri acid.

The first is most instructive, received on 27th November, 1900. When received it was clear and brown, but it was supersaturated with arsenic. It contained 2.6 per cent. of arsenious oxide. On standing in a cool place for some weeks, with occasional disturbance, it gradually deposited crystals on the sides and bottom of the bottle, and when the clear decanted acid was analysed on the 17th January, 1901, it contained only 1.12 per cent. arsenious oxide, the rest having been deposited in the form of prisms, presumably rhombic. When these crystals were placed under the microscope, moist with oil of vitriol as they were, and a drop of water was added to dilute the oil of vitriol, the crystals cleaved into octohedra with flat sides, while some dissolved in the hot acid. On leaving the crystals in the liquid they gradually grew, especially on the flat sides, and in two hours they were large and perfect octohedra.

Photographs show the three stages, though much less perfectly than they were seen under the microscope.

Other samples analysed in 1901 contained:—

1.92 per cent. of arsenic, including crystals deposited.
2.36 per cent. " " " "
2.24 per cent. " " " "
2.5 per cent. " " " "
per cent., of which 1.9 was in the clear acid and deposited.

The arsenic in each case was purified and weighed precisely, and the quantity of arsenious sulphide weighed from 11.32 grammes of acid has been dissolved and reprecipitated and preserved in a bottle for exhibition.

All selenium was removed, as well as other impurities, before weighing the arsenic. Selenium Nichols acid.

Every sample of acid contained selenium, but only in very small quantities. The average was probably about .005 per cent.

One sample contained a quantity which when weighed was .0046 per cent., another .0044 per cent., and others smaller quantities.

If the selenium was present as selenious acid about 22lb. selenium or 40lb. selenious acid must have been delivered to Bostock's from 1st April to the end of October.

Selenium occurs in vitriol chambers chiefly as element reduced by the sulphurous acid of the flues, and Glover towers. The small quantity dissolved in the vitriol is probably selenious acid, and it is removed by the same process which removes arsenic industrially.

J. C. Beer made from partly-cleaned malt contained 1-30th grain arsenic per gallon.

6710. You have also some general observations on arsenic in beer?—The City of Liverpool was completely cleared or beer made from Bostock's sugar before 18th December, and in the County of Lancaster only a few samples here and there were found after that date. But still arsenic did not disappear from the beer sold even by perfectly reliable houses, whose beer was made from no other materials than malt and hops. It became necessary to trace the source of these smaller quantities of arsenic. The barrels, vats, pipes, and other plant of the breweries had been cleaned, and were found to be quite free from arsenic. Hops and finings and other incidental materials were found to be free from arsenic. Yeast was found to be always very slightly arsenical. In some instances yeast was obtained specially from a very large brewer in the Midlands brewing solely from malt and hops, and still the beer made with it was arsenical. A sample of that yeast was found to be as highly arsenical as Liverpool yeast which had been in contact with some of Bostock's sugar. Beer from the brewery before being fined, and before the last proportion of hops was added, was found to be more arsenical than the finished beer. This is usually the case when the quantity of arsenic is small, but yeast and hops do not appreciably purify more highly arsenical beer. Very large quantities of arsenic break down the yeast cells. In slight cases the yeast and the hop residues from which the beer was drained off were found to contain some arsenic, even when the finished clarified beer, as sold, contained practically none. Hops were found to be free from arsenic, the exceedingly minute trace suspected in one case being too small to be identified. The arsenic was in all cases investigated clearly traced to the malt. The malt used was found to contain more arsenic than the finished beer made from it. A sample of beer made from good malt which had been dried with the best fuel was found to contain as much as 1-12th grain of arsenic per gallon before racking. This whole brew was destroyed. Another sample was made from very similar malt, but not analysed until it was ready for sale, and it contained only 1-70th grain per gallon.

Origin of Arsenic in Malt.—Barley for malting was obtained from the ship and from the quay, and from the storehouse before malting, and was found to be free. Malt from Scotch barley, English, Asia Minor, North and South America, and other places always contained arsenic. This arsenic was traced to the fuel.

The quantity of arsenic in malt from good fuel was usually 1-15th grain per lb.

The best quality of malt was dried with the best fuel, as follows:—

Anthracite which contained only	·0075	arsenic per cent.
Coke which contained only	·0035	" "
and	·0025	" "

But this was a very exceptional quality of oven coke, limited in quantity, and it is probable that not very much malt is prepared with such pure fuel as this. Some of the malt dried with this fuel was found to contain ·084, or 1-12th grain of arsenic per lb. The same malt after cleaning (brushing and screening) contained only ·0126, or 1-80th grain per lb.

Other samples were found to contain less arsenic after screening than before, but not so small a quantity as should be; after a single brushing they contained only a distinct trace, while after three brushings the arsenic was almost a vanishing quantity, although arsenic could still be identified from 1lb. of malt.

Malt Dust.—All the samples of dust from the malt screens contained a quantity of arsenic.

Washings of Malt.—Malt, when washed, yielded at once practically all its arsenic to the washing water. The method is not available, however, for cleaning.

Recent Improvements in some Malts.—In the present year, after maltsters had been warned to brush their malt, figures which were obtained from malt as sold were:—

·056, or 1-18th grain per lb., and
·045, equal to 1-22nd grain per lb.

After brushing this was greatly reduced; after triple brushing the quantity could not be estimated. It is probable that most of the beer again: which prose-

cutions have been instituted in the County area since the middle of January have been cases of beer contaminated by malt.

Instances of Particularly Arsenical Malt.—The following figures have been obtained by precise determination in the case of malt dried with inferior fuel:—

1 sample of malt gave 1-9th grain arsenic per lb.

1	"	"	1-7th	"	"	"
1	"	"	1-6th	"	"	"
1	"	"	1-6th	"	"	"
1	contained as much as	1-4th	"	"	"	"

Beer which we are credibly informed was made from some of the above arsenical malts contained 1-5th grain of arsenic per gallon, a serious quantity. I understand the beer was destroyed.

Screening without brushing is not sufficient to remove all the arsenic, because it adheres to the skin of the malt.

But more perfect brushing would undoubtedly remove all but a negligible quantity.

After one brushing some of the above malts came down to 1-25th grain per lb.

6711. (*Professor Thorpe.*) You have had the opportunity of analysing a considerable number of samples of brown oil of vitriol which you obtained from Messrs. Bostock and which you have reason to suppose were of Messrs. Nicholson's manufacture?—I do not know of whose manufacture except from the evidence that was given at the inquests. At the inquests I heard it given in evidence that it was of Nicholson's manufacture, but that all came from Bostock's.

6712. How did you obtain them?—Generally the medical officer of health sent one of his subordinates for them to Messrs. Bostock; one was given to me by Messrs. Bostock themselves.

6713. By what authority did the medical officer of health get into Messrs. Bostock's factory and take the samples?—By Dr. Hope's authority.

6714. Is there any statutory power vested in Dr. Hope?—No, he had no power to go if they had refused to admit him. But they did not; they were perfectly willing to give any facility.

6715. It was simply an act of grace on their part that you got samples through Dr. Hope?—Entirely, except in one instance, and in one instance it was by the permission of the official liquidator. That was the last sample I got.

6716. You give the details of the analysis of the oil of vitriol that you made; speaking generally they were practically saturated solutions of arsenious acid in oil of vitriol?—They were all super-saturated solutions. There was more arsenic than the sulphuric acid could hold permanently. When the arsenic was first dissolved it was in warm acid, which can hold a larger quantity, but some time after I got it, almost immediately after, it began to deposit solid arsenious oxide on the sides and bottom of the bottle, and that process of approaching to equilibrium went on for many months. I do not think all the arsenic that should come out in solid is out yet. It is gradually being produced. Here is a portion of the acid. (*Sample put in.*) When that stands a little the acid will be clear and brown. That was quite clear when I got it.

6717-8. (*Chairman.*) Was the brown oil of vitriol supposed to be intended for use in making glucose?—It was actually used for making glucose.

6719. I thought they always had it clear?—It is not necessary to be clear. There is no harm in it being brown provided there is no arsenic in it. There may be arsenic in it while it is clear, and there may be no arsenic although it is brown.

6720. But it is much less guaranteeable being pure if it is brown than if it is clear as water?—I think no more nor less guarantee whatever.

6721. There is more guarantee if it is clear than if it is brown?—I think not.

6722. We were told by one witness that sulphuric acid ought to be clear as it was a great addition to the guarantee against impurities?—There is a fallacy in that which I will point out. What he no doubt meant was that if the acid has been purified by various processes so as to take out the arsenic, then it will be

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Super-saturated with arsenic.

Colour of acid no relation to arsenic.

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clearer, and that is true; but it may be made clear without any arsenic being removed, so that the mere clearness is no guarantee whatever.

6723. And the brown colouring matter of the brown oil of vitriol may be quite innocuous?—Certainly. Brown oil of vitriol of the old kind made from Sicilian sulphur contains practically no arsenic.

6724. And what is the material that gives it the brown colour?—Traces of organic matter; dust from the air, coal smoke in the process of burning, straw—anything.

6725. (Professor Thorpe.) A very small quantity of organic matter will serve to tinge the oil of vitriol and make it very brown?—Very small indeed, a minute particle of sugar will tinge a whole Winchester of acid.

6726. Does your knowledge of sulphuric acid manufacture enable you to give the Commission any information as to the probable origin of this sulphuric acid?—Yes.

6727. From what particular part of the manufacture has the sulphuric acid been probably derived?—I have not the slightest doubt that it was Glover tower acid.

6728. Why do you say you have no doubt it was Glover tower acid?—Because I do not know anywhere else it could get such a quantity of arsenious acid in it.

6729. (Chairman.) What are we to understand is the substance which makes this as thick as mud and with a large deposit?—Crystals of arsenious oxide.

6730. This has come from the acid by simply leaving it to itself?—Yes, and it has deposited some of the arsenic which there was in excess of what it could retain permanently.

6731. Did Bostock's people use that?—They used it before the crystals appeared, I expect.

6732. It takes some time after it cools before the crystals appear?—Yes. Arsenic is a very slow substance chemically and physically, and evidently it does not come out of super-saturated solution for a very long time indeed, because the first sample that I received had been in the works for certainly a fortnight, probably much more, and I did not observe any crystals until some time after.

6733. Several weeks?—It begun to deposit perhaps within a week, but it had not completed the deposition two months afterwards.

6734. (Professor Thorpe.) Would not that circumstance rather indicate that the arsenious oxide was in some chemical combination with the sulphuric acid?—There is a compound known of SO_3 with arsenious oxide, and I believe this is not that, although I have not absolutely proved it. My evidence, so far as it goes, is two-fold. First I tried to get away as much as I could of the adhering sulphuric acid from the crystals without using water or altering in any way the composition, and then there was very little sulphuric acid remaining to be got on analysis, not enough to account for the compound $\text{SO}_3, \text{As}_2\text{O}_3$. The second piece of evidence is this. Here is a photograph of the original crystals which are prisms in the best sample I have been able to obtain. You may not be able to repeat that on the crystals I have handed in, but this is one sample which was particularly fortunate. On treating the microscopic slide, of which that is a photograph, with very little water, allowing it to pass below the cover, on the slide, as the water reached the acid crystals and diluted the acid—of course, a little heat was developed—a part of the arsenic dissolved, but the majority of the crystals underwent cleavage into imperfect octohedral crystals. Here is another photograph showing that stage. (Photograph put in.) It is not so good as it is in the microscope, because they are a little shaken, but you will see there the remains of some prisms that have cleaved into octohedra with flattened sides. Leaving that under the microscope and watching it, the imperfect octohedra began to grow, and they grow particularly on the flattened sides, so that in the course of an hour or two they are larger and perfect octohedral crystals. Here is a photograph of a more advanced stage, showing the perfect octohedra. (Photograph shown.)

6735. (Professor Thorpe.) That fact throws no light upon the nature of the arsenic in the solution?—No, except by inference.

6736. What you are illustrating is the well-known fact that arsenious oxide is dimorphic?—Yes, but I was using that as evidence that the crystals that come out

are not the compound, but the arsenious oxide crystals in the labile form.

6737. In addition to arsenic you also found that the sulphuric acid you examined contained minute quantities of selenium?—Yes.

6738. And the amount you set down on the average is about .005 per cent.?—Yes.

6739. How did you estimate that amount?—I boiled the sulphuric acid with hydrochloric acid in order to convert any conceivable selenic acid into selenious acid, and I then passed sulphurous acid gas, and got a precipitate of elementary selenium, which I collected. I think I treated it with a little ammonium carbonate, and ultimately, when pure and dried, I weighed it.

6740. You have no doubt in your own mind of the identity of what you weighed as selenium?—None whatever. I proved that it was selenium.

6741. How did you prove it was selenium?—On other portions, not the portion I actually weighed, I converted into selenic acid, reduced it to selenious acid, then I converted into selenium sulphide, in some cases purifying that by ammonium carbonate and by sulphide of carbon.

6742. Did you find selenium also in the sulphuric acid which had been used?—Yes, but not in the elementary state. I also performed a colour test, which is not perhaps of much value, but I did perform the colour test with codeine.

6743. In this particular case?—On some of it.

6744. But you do not attach any importance to that?—I do not.

6745. You are aware, of course, that a large number of substances will give precisely the same colour?—Yes.

6746. Even arsenic acid itself?—But having heard of this being used, I used it for what it is worth.

6747. Do you think it is of no value?—I do not think it is of any value, but I have no doubt about the selenium.

6748. Did you make any search for selenium in the sugars?—Yes.

6749. Did you find it?—It was not a very perfect search: it was an afterthought; I did not find any.

6750. You did not find it in any of the sugars?—I do not think I found selenium in any sugar. I certainly failed to find it in any beer. I also added a small quantity of selenious acid to sugar and to beer, and afterwards analysed it, and I found that.

6751. What was the amount that you did add?—01 grain selenium added as selenious acid per pound, equal to .00014 per cent.

6752. Do you wish the Commission to believe then that had selenium been present to the extent you indicate, you would have been able to find it in the sugar you examined?—I think I should. I do not wish to be too positive about that because, as I said, my examination for selenium was not a crucial one. I did not work it out so perfectly as I should have done had I tackled it earlier. For instance, I am not prepared to go into a witness box and declare upon oath that there is never any selenium in the sugar.

6753. The sugars that you did actually examine, apart from the synthetic experiment you made, were those Bostock's sugars?—In all cases.

6754. But did they contain arsenic?—Large quantities of arsenic. The figures of the quantities of arsenic in those Bostock's sugars I have handed in, and I feel quite convinced that there was not so much as .01 grain of selenium per pound.

6755. Selenious acid or selenium?—Selenium in any form calculated as elementary selenium.

6756. Have you anything to tell the Commission beyond what is here in your précis, which you hand in, as to the modes in which arsenic finds its way into beer?—There are two sources, the arsenical glucose and the arsenical malt. I have nothing to add to that.

6757. Now we come to the method of testing. You state at some length your modes of testing, both qualitatively and quantitatively, for arsenic. Perhaps you would explain in detail to the Commission what you have to say on that point?—It is a rule in my laboratory that any analyses of a substance in such a condition that it may come into court, shall be analysed by two different hands, generally one under my super

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vision, or Mr. Williams, my chief assistant and colleague's supervision, and one by another skilled chemist, working quite independently, and further, if possible, by two different methods, so that not only do we have two independent analyses, but the check that two different methods afford to prevent the possibility of an error slipping through. In the case of the arsenic in the beer, those two methods were, first a purely qualitative test which gives, carefully performed, a pretty good general idea of quantity within certain wide limits. The qualitative test is to take a small quantity, not 200 or 250 cubic centimetres, but 30 cubic centimetres, or 50 cubic centimetres, in a small flask; add 10 per cent of its bulk of pure hydrochloric acid, which has been tested and found absolutely free from arsenic, and add a piece of thin electrolytic copper foil about 5-16ths of an inch square; boil vigorously on a sand bath for half an hour; pour off the beer, and note the appearance of the copper. If it is not thickly coated, return the beer to the flask and boil for another half an hour, and again pour off and examine the copper. If the copper is now thoroughly coated it is removed, washed and dried, but if there is only a slight coating, a slight tarnish, it is returned to the flask and the boiling continued with the beer for another hour, that is two hours altogether, then removed, washed and dried. If the copper has been removed before the whole of the arsenic has been deposited, which often happens, a second piece of copper is added and boiled for an hour, or whatever time may be necessary, until you are satisfied that all the arsenic obtainable in that way has been removed upon the copper. The reason for not continuing with the same copper is that when the deposit becomes thick it is apt to scale off either in the flask or later, when it has been transferred to a tube. The dry copper is then rolled into a cylindrical form and introduced into a clean dry tube of hard glass, 3-32nds of an inch diameter internally, or about that, about 2½ inches long, previously warmed in a flame. The end of the tube containing the copper roll is very cautiously heated, holding it first about an inch above one of the flames of a Bunsen rose burner, turned very low, and when the arsenic has left the copper, it is driven slightly up the tube to a clean part by holding the tube rather nearer the flame. During the sublimation the tube is held nearly horizontally. That is an ordinary method of examination, and it is only made very precise for the purpose of getting an approximation to a rough quantitative idea.

6758. In other words it is the Reinsch method, of which you have given us so full details of the way you carry it out?—Precisely.

6759. Having in this way got some rough idea of the quantity, how do you proceed to more accurately estimate the quantity?—I then take another portion, much larger, a litre or a litre and a half, or 2 litres if possible of the beer, and analyse it by Fresenius's well-known method, with a slight deviation, for an object that I will mention. It is evaporated first in a large porcelain dish on a sand bath to about 250 cubic centimetres. The dish is then transferred to a boiling water bath, 75 c.c. of pure concentrated hydrochloric acid added, and then 2 grams at a time of potassium chlorate, with constant stirring until a thin yellow liquid is formed, and then a further 2 grams of potassium chlorate is added, and it is allowed to cool. When it is cool it is filtered, washed and evaporated, so as to get off the whole of the chlorine or chlorine compound that is evolved. Again it is allowed to cool, and saturated with sulphur dioxide to reduce the arsenic to the arsenious acid. The sulphur dioxide is evaporated off, and then the hot solution is treated with sulphuretted hydrogen, heated in a water bath ultimately to nearly expel the sulphuretted hydrogen. It may be necessary to continue passing the sulphuretted hydrogen gas for hours, or it may be all finished generally in an hour. In this case an hour is enough, I think. Then the precipitate is filtered and washed to free it from chloride, which is very important; and it is digested at this stage with a hot mixture of 2 volumes of 5 per cent. solution of ammonium carbonate with 1 volume of 10 per cent. solution of ammonium hydrate, the liquid being poured repeatedly through the filter. This is for the purpose of dissolving at this stage the arsenious sulphide, and getting rid at once of any antimony or lead, or metals of that kind that might be present as impurities. The usual way is to leave that till later. I find it better to get that done at this stage. Then the solution is evaporated to dryness, the residue moistened with fuming nitric acid free

from chlorine; the solution is evaporated to dryness, and the yellow residue moistened with concentrated sulphuric acid and heated in a water bath for an hour. To the thick black solution thus formed a few small pieces of Swedish filter paper are added to render the mass pasty—this is taken from Fresenius—transferred to an air bath, and heated to 160° centigrade, taking great care that the heat never exceeds 170°, until the mass is friable and yields a colourless solution. That is a process of charring, which effectually reduces arsenic acid to arsenious acid. The residue is then extracted with hydrochloric acid dilute. The residue is filtered and washed with water containing hydrochloric acid, and then precipitated in hot solution with the sulphuretted hydrogen again. It is warmed in a water bath to expel the excess of sulphuretted hydrogen. The precipitate is washed, dried and digested on the filter paper with bi-sulphide of carbon in a small beaker, that is to remove sulphur that may be present as sulphur, and then is dried and digested with about 15 cubic centimetres of a hot mixture of ammonium carbonate and ammonium hydrate as before. This solution is filtered and evaporated to dryness in an accurately weighed porcelain dish or capsule, carefully dried at fully 100° until the weight is constant. The precipitate is now probably pure arsenious sulphide. If it is not, it is re-dissolved and the whole purified again, and re-precipitated. In good hands that is seldom necessary. If it is necessary I find generally that the weighing after and the weighing before the second purification gives exactly the same figure.

6760. Would you kindly explain why you think it necessary in the case of beer to make use of the same drastic method of breaking up the organic matter, that you would do in an ordinary toxicological enquiry. In the first place, perhaps you might tell the Commission how far you think there is any direct evidence of the formation of any combination of organic matter in beer?—Those are two quite different questions.

6761. Perhaps it would be better to begin with the direct evidence as to the possible occurrence of any organic combination of arsenic in beer?—There is a little ambiguity in the phrase "organic combination." I will divide that into two parts if you will allow me. In December last I thought it was quite a possible thing that there might be some compound of arsenic other than arsenious oxide. Medical men were expressing considerable doubts whether the poisoning that took place was due to arsenious acid, and whether there might not be a more poisonous compound not known. I therefore took a large quantity of a certain barrel of implicated beer and distilled it, once into an acid dish, and once into an alkaline flask, and examined both of these for arsenic, but I found nothing, and I am satisfied that there is no very volatile compound of arsenic present in beer. There is no cacodyle or homologue of cacodyle. Moreover, the odour of beer would be offensive if these were present, and I am quite sure that they are not. Also, I did not feel the necessity that medical men felt for supposing that there was some extra poisonous body, because I account for all they feel difficulty about in another way. First, the large quantity of liquid very easily absorbed brings the arsenic quickly into the circulation, and it all acts or gets an opportunity of acting, whereas where they administer arsenic in the ordinary way, or particularly when arsenic is administered as a poison, a portion of that, and sometimes a very considerable portion, never gets into the circulation; it passes out through the faeces in all probability. And secondly, it is perfectly clear to me now that on the whole the quantity of arsenic present in beer has been very generally and very greatly understated, so that the quantities that have been drunk have been much greater than medical men suppose. I think those two things may account for all that they find a difficulty about.

6762. (Chairman.) There was more arsenic than the analysis had shown?—Yes; as a rule, and considerably more than the medical men have been told, or that they have gathered has been present.

6763. (Sir William Hart Dyke.) Do you mean analysed since this epidemic or previous to this epidemic?—Since this epidemic. Before the epidemic they did not suppose there was any arsenic in beer. It was exceedingly difficult to convince them that there was.

6764. (Chairman.) Do you think that probably before the epidemic there has been a deleterious amount of arsenic in many beers?—Undoubtedly.

6765. (Professor Thorpe.) What is your evidence for

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Question of combination of arsenic with organic matter of beer.

Amount of arsenic in beer often under stated.

Beer arsenica before the epidemic.

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that. You say you are undoubtedly of opinion that there was a considerable quantity of arsenic in beer before the epidemic manifested itself. Is that what I gathered you to say?—Yes, in some beer.

No arsenic
in brewing
plant.

6766. What is the evidence you have of that?—That is a somewhat long story. In the course of the examination of the implicated beer several brewers asked various chemists, including myself, to help them to get the arsenic entirely eliminated from their works, and for that purpose they brought samples of the beer before it was finished, at various stages, from the vats, and I found that the arsenic did not disappear so quickly as I thought it ought to disappear after the use of Bostock's sugar was discontinued. We thought that it might be arsenic adhering to the vats and various pipes, and other portions of the plant. That was carefully investigated. I had shavings taken off the vats and every imaginable thing examined, with the result that we found that all the arsenic had been completely cleaned out of the plant; there was nothing left there. Then we tried all the materials, and we found arsenic in yeast.

6767. (Chairman.) In yeast that had been used before the epidemic?—In the yeast that was being used after Bostock's sugar was discontinued.

6768. That was a continuation of the yeast that had been used during the time of Bostock's sugar?—At first it was. Then they discontinued their own yeast, and sent to a brewery in the Midlands for a fresh supply of yeast and brewed from that, and still arsenic was found in the product. I then asked for a specimen of the yeast as it came from the Midland Brewery, which was one that used no sugar or any kind, brewed solely from malt and hops, and I found as much arsenic there as in the yeast that had come from beer that had been in contact with Bostock's sugar. They were no better for getting fresh yeast than by using their own. We pursued the search for the source of the arsenic, and very soon found that the source was malt. Of course, we then stopped the malt and told the medical officer. However, he did not require to take any steps, for the maltsters, who were very concerned about this, came down by the next train with specimens of their barley and their fuel. Of course, we had to forbid the use of the arsenicated malt. The result of the investigation and the efforts of the maltsters was this. I will give you the result of the examination of typically good fuel. Anthracite, which contained only .0075 of arsenious oxide per cent, and coke, which contained only .0035 and .0025 of arsenious oxide per cent., was used with certain samples of malt, and the malt dried with that fuel, which is the very best fuel in England, contained .084 grains of arsenic per pound—1-12th of a grain per pound on the surface of the malt. That was what some of the best beer was being brewed with.

6769. Was that malt which had already been brushed and screened?—No; that had neither been brushed nor screened.

Improvement
on brushing.

6770. Would it be brushed and screened before being used by the brewer, or might he ignore that?—Not in that case. I will tell you the result of brushing. The same malt, after being brushed and screened, contained only 1-80th of a grain per pound, which was of little consequence; and when it had undergone the process of brushing three times we could hardly detect—we could just detect it—but we could hardly detect the arsenic at all. I should say here that when the malt is crushed up and mashed, and the arsenic extracted from that, you do not get the whole; some of the arsenic so combines with the organic matter that you cannot practically get it out unless you destroy the whole of the malt, which is a very slow and tedious process, and quite unnecessary, because, if the malt is left entire and washed well with water containing a small quantity of alkaline carbonate, the arsenic dissolves quite readily, and we get practically the whole easily in that way, and then estimates of the quantity were obtained in that way.

6771. Would the washing not bring it out from the crushed malt?—Not entirely. From the crushed malt you do not get it all out entirely by the water. Some is lost by adhering to the solid matter of the malt.

6772. (Professor Thorpe.) What you mean to say is this in effect:—that when great care such as you have mentioned is taken in the preparation of malts from fuels which are reasonably free from arsenic, nevertheless arsenic can be found in the malt?—Yes.

6773. And you infer from that, that inasmuch as malt of even worse character as regards arsenication must have been previously used, therefore beer containing

arsenic must have been in vogue prior to the epidemic?—Yes, but I am more precise than that.

6774. What more evidence is there, then, as to the amount?—In the course of examination of other samples of beer that we condemned for containing arsenic concerning which the brewers declared, and with truth, I believe, that the beer was brewed entirely from malt and hops, we asked for samples of the malt, and we obtained the following figures from different samples: 1-9th of a grain of arsenic per pound; 1-7th of a grain of arsenic per pound; 1-6th of a grain of arsenic per pound; another one 1-6th of a grain of arsenic per pound; and one contained as much as 1-4th of a grain of arsenic per pound.

6775. (Sir William Church.) Were those unbrushed malts?—Yes, as they came from the maltsters, and as they were being used by the brewer, and beer which we were credibly informed was made from two of these arsenical malts contained as much as 1-5th of a grain of arsenic per gallon. Of course, that beer was condemned, and it was all destroyed, but if it had not been interfered with that would all have been sold with a guarantee, probably, that it was made from nothing but malt and hops; and if that was occurring several weeks after the scare was made public, of course there is no doubt it was happening several weeks and years before the scare.

6776. (Professor Thorpe.) Do you wish the Commission to believe that beer brewed from malt and hops under normal conditions contains as much as 1-5th of a grain per gallon of arsenious oxide?—Yes, it did sometimes.

6777. Do you think it is a common occurrence with beer?—I should think not; I should think it is a very uncommon occurrence, but if malt is dried with gas coke, as it sometimes is, then I should think it was very likely to occur in such malt unless it were carefully brushed.

6778. Have you reason to believe that evil consequences would result from drinking beer containing as large a quantity as one-fifth of a grain of arsenic?—Medical men say that serious consequences occur from drinking much less.

6779. Is there any evidence of the occurrence of anything approaching in character this epidemic during the last forty or fifty years when that character of beer must have been in vogue?—That is a medical question which I am not qualified to go into, but there is undoubtedly a considerable impression arising in the minds of medical men that some of the symptoms of what they call peripheral neuritis that had been observed before the epidemic may have been due—I only say may—to arsenic in beer, which has come from other sources than sugar.

6780. But this character of beer that you are mentioning is the universal type of beer; it is the beer which has been brewed all over the country?—It is very seldom, I hope, made from malt which has been dried with gas coke.

6781. (Sir William Hart Dyke.) Did you discover what fuel had been applied to this malt?—I was not, of course, able to arrive at that. The maltster was naturally very reticent about that; but I have no doubt whatever that it was gas coke; and I may say that he has since then discarded his process. He has also changed his fuel, brushed the malt, and has reduced the quantity to what may perfectly well be neglected. In the present year, after maltsters had been warned to brush their malt, figures were obtained showing 1-18th of a grain of arsenic per lb., 1-22 of a grain of arsenic per lb., 1-80th of a grain of arsenic per lb., and during the last month the quantity is so minute that I sometimes cannot identify it from a pound of malt.

6782. (Professor Thorpe.) Does this finish all that you have to say as to the evidence that there may have been a considerable quantity of arsenical beer in existence prior to the epidemic?—Of slightly arsenical beer.

6783. I do not quite understand why peripheral neuritis, then, under those circumstances should not have been more widespread than it apparently has been?—May I point out first that the quantity of beer containing so much as from 1-10th to 1-5th of a grain has undoubtedly been a very small proportion of the total made; secondly, that a considerable number of maltsters did brush their malt before the epidemic; thirdly, that many brewers brush their malt somewhat after it comes from the maltsters. All these lessen the risk; fourthly, the number of people drink-

Dr. J.
Bryson.

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Arsenic
malt.

Quantit
found.

Arsenic
all-malt
beer.

Arsenic
malt
diminish
since
epidemic

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ing a very large quantity of beer is quite limited. You have to have a coincidence of five things before you have the probability of neuritis.

6784. I must point out to you that these coincidences are just as likely to happen in Bristol, Plymouth, Southampton, London, or anywhere you like where large quantities of beer are drunk?—Then I would next point out to you that medical men say there has been a considerable prevalence of slight peripheral neuritis in the North of England as compared with the districts round London and Scotland. In places where beer has been drunk in large quantities, three gallons of beer a day, you have had peripheral neuritis, and the question with them is whether that has not arisen from this imperfect malt.

6785. (Chairman.) Are there differences between the northern districts and the districts round London? Are there more cases of excess of beer drinking in the North than in the South?—I do not know that. It is very difficult to find out how much beer a person drinks. He is very unwilling to tell.

6786. Are there differences between the malts in the northern districts and the malts in the southern districts? Do you see any reason for supposing that there were more case of arsenic in the northern district malts than in the southern district malts?—I have no means of knowing that, because I have had no experience of the southern malts; but I have had some amount of evidence of what has been sold in the North and in the Midlands.

combination
arsenic
organic
matter of

6787. (Professor Thorpe.) To bring you back to the point which we somewhat departed from, you told us how you eliminated in your mind the possibility of the occurrence of cacodyl or anything analogous to cacodyl as a form of organic combination of arsenic. But you said, apart from that, you had reason to believe that the arsenic was in some form of combination with the organic matter, because you had to destroy that combination by the method you have told us. What is your evidence for that?—My supposition does not go further than that the arsenious oxide itself is combined with organic matter, and is held back and prevented from being precipitated much in the same way that iron is held back by organic matter, sugar and so on, from being precipitated by ammonia. It is not necessary to suppose, although it may be true, that the arsenic is combined with organic matter in the same way as iron is combined in ferrocyanide. It is quite enough that the arsenic should be, as arsenic, combined with organic matter in some way that prevents precipitation. I do not know further than that.

6788. That is a surmise?—No; I do not surmise; there is something more than that.

6789. But you surmise to that extent, viz., that there is some agency, which you call organic matter, which keeps the arsenic up and prevents it from being thrown down by the ordinary tests which chemists apply for its discovery?—I do not surmise that. That is a fact which I find by experiment.

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6790. Perhaps you will explain to us, then, how you find it?—Here is an example of the evidence, four analyses for comparison. First, an arsenical beer that I know all about is taken. One litre of the beer is concentrated, is acidulated, heated and precipitated by sulphuretted hydrogen, the gas being passed until the laboratory is closed for the day. It is allowed to stand all night, and then it is not quite clear in the morning. Then the beer is filtered, and the precipitate is examined. The filtrate is again heated and treated for nearly a day with sulphuretted hydrogen and filtered. The beer filtrate from the arsenic deposit is again treated with sulphuretted hydrogen and the following day that is filtered, and the precipitate examined. The filtrate is so treated for a third and a fourth time, with a precipitate in each case more or less, and each precipitate has the arsenic estimated in it. Finally, the filtrate is oxidised to destroy the organic matter, and the arsenic is estimated by precipitating as sulphide distilling with hydrochloric acid and weighing finally as sulphide. The first precipitate yielded .001 gramme of arsenious sulphide.

6791. When you say the arsenic is volatilised by distilling with hydrochloric acid, do you mean you treat an impure sulphide with hydrochloric acid and distil it?—Yes.

6792. That is all you do?—I treat it as nearly as I can by the Somerset House method.

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6793. I should like to know exactly what you do?—For my present purpose it is not necessary to say, I think, how I do it. I get so much arsenic by any reliable way I do not lay stress upon the method there. It is the previous part that I lay the stress upon.

6794. Pardon me, this is very essential. You get an impure sulphide of arsenic which you purify in the manner you described, but not fully described. I should like to know exactly what you do?—I was only trying to save time. I will take the first precipitate.

6795. Cannot you shortly describe what you do with those arsenical precipitates? They are all of the same character?—The precipitate was washed, slightly dried in the water oven for an hour or two; the filter with the precipitate was placed in a distilling flask, and strong hydrochloric acid added with ferric chloride and ferrous sulphate, and was then distilled into water; a further quantity of hydrochloric acid was added and distilled again; and this was repeated until there was no arsenic left.

6796. That is all I wanted. I merely wanted to get certain additional details which you have now given, which you did not give before?—I did not think it was necessary. That was finally obtained as arsenious sulphide and purified, dried, and weighed.

6797. Will you tell us shortly what was the effect—that you did not recover all the arsenic that you knew to be there?—The first precipitation with sulphuretted hydrogen yielded .001; the second yielded .0005; the third yielded no arsenic; the fourth no arsenic; and there was left in the filtrate, and recovered after destroying the organic matter, .0055, making a total of .007 of arsenious sulphide, which corresponds to .39 grain of arsenious oxide per gallon.

6798. What was known to be there?—I am coming to that. In the second experiment a similar course was pursued, except that after the fifth precipitation a good deal more hydrochloric acid was added before passing the sulphuretted hydrogen, and a good deal of the sixth precipitate was obtained. There was a seventh precipitate obtained before the final filtrate was taken for the destruction of organic matter. The result was that the first precipitate yielded .001 as before. It may be a coincidence, but it is a remarkable one. The second one yielded .002, much more than the previous one. The third, fourth, fifth, sixth, and seventh yielded no arsenic, and there remained recoverable after destruction of the organic matter .004, which brings up the total to .007, as in the first experiment.

6799. (Sir William Church.) Were those the same beers?—The same beer.

6800. (Professor Thorpe.) Does that mean that when you pass successively sulphuretted hydrogen and allow the liquid to stand, and filter it, you get the arsenious sulphide down little by little?—No.

6801. Yes, you do. Some of the arsenic remains in solution; but notwithstanding your arsenious sulphide is coming down little by little?—No; it only comes down in the first and second precipitations. It does not come down in the third, fourth, fifth, sixth, and seventh days' passing of gas, and the great bulk of it remains in the final filtrate.

6802. (Chairman.) So that you get four by your final process, whereas the previous process only gave three?—Yes, making a total of seven milligrammes.

6803. That was all you could get out?—Yes, in the second experiment. In the first experiment we got .0055 by the last process, and only .0015 by the other. In the third experiment another litre of the same beer, first destroying the organic matter, gave the whole precipitate at the first passing of the gas in a much shorter time, and it amounted to .007, the same total as before.

6804. In this last case you oxidised the organic matter in the beginning?—Yes, and then you get the whole of it at once. In the fourth experiment pure beer was taken, and .0052 gramme of arsenious oxide added to a litre of the beer. The organic matter was not destroyed; it was acidulated, heated, and the gas passed direct, and the whole of the arsenic was obtained in the first precipitate. That is the sort of evidence I have that the arsenious oxide is compounded to some extent with the organic matter so that it is not precipitated.

6805. (Professor Thorpe.) Is what you wish us to believe that when you add, we will say, arsenious oxide to finished beer, you can by the ordinary well-known methods recover it?—I hesitate to take the word

Pure beer after addition of arsenic behaves differently to beer brewed with arsenic.

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"well-known methods." I say they are all well-known methods.

6806. Your method?—The simple method without destruction of organic matter.

6807. You recovered it by your method straight away?—I recovered it by simple precipitation as if the organic matter was not there.

6808. When, however, the arsenic was brewed with the beer you could not recover it?—That is so; not nearly the whole of it. It may have been due to the brewing or to long keeping, or it may have been due to other substances that they add. It may be the sulphite, or it may be any conceivable thing; but as a matter of fact the beer which was brewed and treated in various ways—we do not know how—and that was sold, did not yield more than a fraction, and a varying fraction, of the arsenic known to be there, until the organic matter was destroyed.

6809. You say somewhere or other in your *précis* that the fact, namely, that you cannot recover the arsenic from the beer, has been known to you for 25 years?—I did not say beer. I said organic matter.

6810. I understood you to say that the fact that you could not recover the arsenic from beer has been known to you for 25 years?—I did not intend to say beer, but from the organic matter containing arsenic.

6811. (Chairman.) You distinguish between arsenious acid added to the beer in one experiment and arsenious acid that has somehow or other got into it in the brewing or manufacture?—What I mean by that is exactly this, that the finding of all the arsenic from a mixture which anybody makes with pure beer for comparison is no argument in favour of the idea that you get all the arsenic by the same method from what you call Bostock's beer. The importance of that lies in this, that the various gentlemen who have applied various processes, with what I believe to be incorrect results, have generally used the argument that they have compared the results with the quantities added by themselves, but they have added those quantities to beer already brewed, and that is the fallacy. They are not justified in assuming that the results are correct when that is all their evidence.

6812. (Professor Thorpe.) If it is shown to you that no matter whether the arsenious oxide is added to the finished beer, or whether it is added to the wort, and the beer is brewed, and the results are the same—supposing that is proved to you, what becomes of the supposition that there is some combination formed in the process of fermentation?—That evidence is not crucial enough. It does not disprove the fact that you do not get nearly all your arsenic from Bostock's beer, whatever the reason may be. If you can make beer to which you add arsenic and can get the whole of the arsenic, it does not prove that I get all the arsenic from Bostock's beer, or that you would get all the arsenic from Bostock's beer.

6813. It proves that both of us ought to?—No, I do not think it does. It proves that something happens in Bostock's beers that does not happen in others.

6814. (Sir William Church.) You have said that "when sulphuretted hydrogen is passed into acidulated arsenical beer, whether concentrated or not, only a portion of the arsenic is precipitated; this is a colloid precipitate which does not coagulate well, and it is very difficult to filter. An unknown but large proportion remains in the beer. This has been known to me for 25 years." That is, I think, what Dr. Thorpe was alluding to?—I do not mean beer specially. It is badly worded. What I meant there was that as applied to the presence of arsenic in organic matter generally, and not specifically beer, that fact has been known. I did not actually think of beer 25 years ago. If I had I should have known that.

6815. But this peculiarity of the precipitated sulphide has been known to you for 25 years?—Yes, that peculiarity of the sulphide of arsenic and the fact that you could not get it from organic matter without destroying the organic matter, has been well known to me and others for more than 25 years.

6816. (Chairman.) Instead of the words "arsenical beer" in this statement, you would substitute acidulated vegetable or animal organic matter containing arsenic?—Yes.

6817. This statement will be correct then?—Yes, if you make that correction it is strictly right.

6818. When sulphuretted hydrogen is passed into

acidulated organic liquid matter containing arsenic, whether concentrated or not, only a portion of the arsenic is precipitated. This is colloid precipitate, which does not coagulate well, and it is very difficult to filter. An unknown but large proportion remains in the beer. This has been known to me for 25 years?—There, if you put "remains in the liquid," take out the word "beer;" then it will be right.

6819. "An unknown but large proportion remains in the liquid?"—That will then be quite right.

6820. (Dr. Whitelegge.) That would not be strictly true of arsenic newly added?—In the case of this test that I made I was surprised to find that I did get the whole of the arsenic down. It had not in the short time, I suppose, under the circumstances compounded itself in such a way that it was held back. It is a very slow thing. It does not compound itself quickly, and does not come out of the compound quickly.

6821. The proposition would relate not quite strictly to all arsenic present in organic liquid, but to arsenic that has had time to assume some change?—Some unknown change. I do not know what the change is.

6822. (Sir William Church.) I understood you to say to Dr. Thorpe that the fact of his being able to recover the whole of his arsenic from beer brewed from arsenical materials would not satisfy you that in another case of a beer brewed with different arsenicated materials you would be able to do it?—The experiment he alluded to is a very important one and a very interesting one.

6823. But it would not be to you conclusive that the same would occur under all circumstances?—No number of negatives of course can disprove my positive, and it is not my positive alone. These four experiments I have just alluded to are typical, and they were very carefully done by undoubtedly correct methods.

6824. Had you any further experience of the same sort?—Yes, there are some others which are not quite in a fit condition to be sent up here in the shape of figures. When I got sufficient evidence I did not go further for myself. I am quite satisfied, but if the further details will be of more satisfaction to you I can send you more from another strength of beer.

6825. You have had other details which confirm in your own mind that opinion?—Yes, I had further evidence which is of some importance. I have some dishes here which I should have produced before. These dishes show the amount got in the different precipitations.

6826. (Chairman.) What is the yellow matter we see?—That is the sulphide of arsenic. This dish shows a precipitate which was before the Courts, and, I think, will be again. That corresponds to 1.5th of a grain per gallon.

6827. (Dr. Whitelegge.) These actual samples were not weighed?—That was a sample I weighed in the porcelain. It was carefully dried and weighed fresh from the desiccator.

6828. (Chairman.) How did you weigh this precipitate, because we here see it a hard coating on the porcelain?—The dish is carefully dried in a desiccator, taken from a desiccator and weighed, and that stuff is got into it and weighed again.

6829. The weight of the dish is taken, and after that it is weighed with this precipitate?—Yes.

6830. What is the actual weight of this precipitate, 1.354 R.D.?—That weighs .006 gramme. That was from 1,500 grammes, a litre and a half of beer. What I wanted to say about that is this, that other gentlemen working by mirrors and other guessing methods, call that 1.30th of a grain, 1.15th of a grain, 1.40th of a grain, and Somerset House return it 1.30th of a grain.

6831. (Chairman.) And you find it to be 1.5th of a grain?—I find that amount which corresponds to 1.5th of a grain per gallon. That is an actual case, and it was that which led me to go into all these details. There is a corroboration of the substantial correctness of the figure 1.5th of a grain per gallon, in the fact that I was subsequently informed that the brewer of the beer was supplied with malt by the same maltster who supplied the two samples in which I have already mentioned we found 1.6th and 1.9th grain arsenious oxide respectively, and which corresponded with 1.5th of a grain arsenious oxide in the beer which was brewed solely from them and hops.

6832. (Dr. Whitelegge.) Would you say that whilst the other methods of analysis may omit some arsenic,

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Divergence of result obtained by different analysts applying different methods beer.

in the way you perform the experiment there cannot be an over-statement?—That is an under-statement, because I lose a little. In comparing the two methods I find such figures as these, '35 instead of '39 grains per gallon. I lose, therefore, a small fraction like that. What I say is, that when I get that, and produce it, and weigh it absolutely pure, there is at least that amount, there cannot be less, unless I have arsenic in my materials. I wish to state to the Commission the precautions I take to prevent error from the materials employed. First, every batch of every re-agent is tested, every Winchester quart, or every bottle of hydrochloric acid, is carefully tested, and if there is the slightest trace the bottle is rejected and not allowed to enter the place. Secondly, blank experiments are made with the same quantities of exactly the same ingredients that were employed upon that beer, in that experiment, using pure beer in the same quantity, with the result that we get a blank dish, no weighable quantity of anything. There is a third corroboration of that, that with the same ingredients we have estimated much smaller quantities of arsenic in both beer and malt, and have found quantities as low as 1-70th and 1-80th, and less. Now, if the impurities came from the ingredients, we should never find so small a quantity as 1-70th, it would be impossible. We should find the same quantities of impurity every time. Therefore, I think the evidence is absolute that at least that amount of arsenic was present there.

6833. (Chairman.) What are the weights of the first and second precipitate in experiment A?—001 gramme is the weight of the amount precipitated on the porcelain there.

6834. One milligramme on the porcelain?—Yes. You have the figures down.

6835. I wanted to know the weight on the porcelain?—001 gramme on that porcelain from a litre of the beer.

6836. On the second porcelain, what is the actual weight?—002.

6837. Then on the third, fourth and fifth we have nothing?—Nothing.

6838. And nothing was shown in weighing?—No.

6839. On the sixth we see nothing?—That is after the addition of more hydrochloric acid, and the further precipitation of sulphur and organic matter, and there is no arsenic on the porcelain.

6840. And no addition to the weight of the porcelain?—None.

6841. And the seventh of experiment A, was that still with further hydrochloric acid?—That is simply the filtrate from the sixth, and there is nothing there.

6842. Now the final precipitate?—004 gramme.

6843. The weight of this precipitate then is four milligrammes?—Yes. They are the figures I gave you before, dish A is the second experiment, and then I gave you the calculation into grains per gallon, which was '39. It is the same for B. I have the B dishes if you would like to see them, they correspond to the first experiment which I mentioned.

6844. Can you tell us the smallest quantity of precipitate on the porcelain that you can weigh?—I do not think I can, because it depends on the balance. I have a balance that I could employ if I wish to do it, that would give 1-10th of a milligramme or less; but I do not think it necessary to use that.

6845. What is the weight of the porcelain itself?—It varies, say, 19 grammes for a large precipitate, and five grammes for a small one.

6846. And you can weigh 1-10th milligramme on 19 grammes?—I should think one might do so, but I never did it. I do not trace the fractions of a milligramme beyond a half or a quarter. I should not trace my ordinary work to the 1-10th of a milligramme, but it can be done when desirable.

6847. Have you any case in which the precipitate is visible, and yet not perceptible on your balance in this experiment?—No yellow precipitate.

6848. If it is visible at all you would be able to weigh it in the balance?—Yes, in that experiment.

6849. Do you think there is any case in which you could weigh it in the balance, and yet it is not perceptible to the eye?—Not the arsenious sulphide; I can see as little as I can weigh; but I think I ought to say here that in official work there is always the check of

the Reinsch test. I will give you a very important example. In some of the evidence that has been given before you, I learn that you were a little concerned about a certain preliminary report that I had made regarding a sample, calling it a "small quantity" in one case, and saying merely "arsenic" in another. When I came to the figures I did not get quite so much from the sample that was recorded provisionally as simply arsenic, as I got from the sample which was recorded as a small quantity, and I was not quite satisfied with the result, because it did not quite agree with the Reinsch indications, which indicated rather a larger quantity from the one recorded as simply arsenic; and I repeated the analysis, so that by the time the case came into Court I was able to prove a larger quantity. Some had been lost in the first estimation. There is an illustration of the use of the second process as a check.

6850. What do you call the second process?—The Reinsch test.

6851. What you stated as to the necessity for oxidising away the organic matter, does that apply to the Reinsch test as well as to the precipitation test?—Not nearly so much. I think we do not quite get all the arsenic down by the Reinsch test, but we get a very much more nearly total quantity than we do from the Marsh, or by simple precipitation by sulphuretted hydrogen.

6852. The precipitation by sulphuretted hydrogen is surer than either of the other two tests?—For quantitative purposes, provided the organic matter has been first destroyed, otherwise it may be worse.

6853. So that the Reinsch test is not so much affected by the peculiar organic affinities you have discovered?—Not if you boil long enough; but the one hour generally employed is often not sufficient unless your object is to fail to get small quantities of arsenic.

6854. What about the organic affinity you have discussed, and the Marsh test? Will it vitiate the Marsh test?—I have five objections to the Marsh test, of which that is one.

6855. You consider that the Marsh test is in this respect worse than the Reinsch test?—Immensely so. Twenty years ago it was my duty, along with another very careful and reliable chemist, to investigate a series of murders by arsenic in which there were many victims. In one case of a child there was a very small quantity of arsenic. We applied the Reinsch method and we applied the Marsh method. The quantity was far too small for weighing, and we failed to get evidence we could use for judicial purposes by the Marsh test. But we got perfectly clear and unmistakable evidence by the Reinsch method, and on that we gave evidence in Court. I instance that as a crucial test made under circumstances of a strong feeling of responsibility. Since that time we have never relied upon the Marsh test where there is organic matter.

6856. On that occasion, did you use the method of oxidising the organic matter?—Not in that one particular body, because the quantity was much too small. In the case of other bodies at the same trial we did. We used very much the method I have described, but we went further, and instead of stopping with that yellow precipitate, we oxidised it and converted it into arsenic acid, and precipitated it as arsenate of silver, which gave a further link in the chain of evidence. I do not go so far as that in beer analyses for two reasons. First, we have got our confirmation by the octahedral crystals from the Reinsch test, and that is confirmation qualitatively, and the yellow precipitate in that test is an exceedingly good one to show to a magistrate, or to this Commission. Here are the crystals. (Tube shown.) You see there the crystals obtained by the Reinsch method from an ounce of beer (No. 858), and there is another tube containing the crystals from an ounce of beer. This is the porcelain dish 858. I certified 1-10th, and I found 1-9th really, and there is the arsenic in the form of sulphide. I have handed you the rough tube containing only a portion of the crystals from an ounce of the beer. You could not possibly produce those crystals in such quantity from an ounce of beer if there was not at least 1-10th. Two other gentlemen found 1-80th and 1-100th of a grain. Somerset House certified 1-100th, Dr. Stevenson estimating it, of course, not precisely, can easily distinguish between 1-100th and 1-10th by the Reinsch test; he applied both Reinsch and Marsh tests, and he says that from these he makes it to be '17 of a grain per gallon. In a letter to me, he says he believes that these esti-

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Tests for arsenic in beer compared.

Divergence of results of different analysts using different methods.

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mates of his are correct within 20 per cent. If you take 20 per cent. off that, you still have 1-7th of a grain per gallon against my 1-8th.

6857. So that that agrees with your 1-9th?—He makes it a little more than my 1-9th. Then to Mr. E. W. T. Jones, a very careful public analyst at Wolverhampton, I sent a small quantity only, and using 50 cc. in Reinsch's method he also says there is at least 1-7th; so that there is Stevenson by Marsh and Reinsch, and Jones by Reinsch alone, and myself, and I think five of my assistants, each separately getting over 1-9th by Reinsch's test, and there is finally my precise estimate in that dish of 1-9th.

6858. How much was the amount weighed on this dish, No. 858?—003 of a gramme from a litre and a half.

6859. In this case it was just one precipitation. You had taken your proper precaution of oxidation beforehand?—Yes. That was my final method at that time.

Nicholson,
acid super-
saturated
with arsenic.

6860. (Sir William Church.) Going back to what Dr. Thorpe was asking you, is the slow deposit of arsenious acid from sulphuric acid a well known and a regularly recognised fact?—Not until last year. No one has ever seen, as far as I can ascertain, anything like such a quantity of arsenic in sulphuric acid before. The largest that people are acquainted with is about 1-5th of that.

6861. (Dr. Whitelegge.) Even in Glover tower acid?—My 2-6 per cent. sample is called the record, I think.

6862. (Sir William Church.) You think it is quite possible that when Messrs. Bostock had this acid delivered to them there was nothing peculiar in its appearance?—There was nothing when it was delivered to them, and there was nothing when I got it from them first on the 27th November last. It would not have attracted attention then as being anything out of the way. If it did deposit, it would not be seen in the carboys.

6863. With regard to the malts you spoke of, are you well acquainted with malt from different parts of the country?—I have examined malts from different parts of the country.

6864. I ought rather to say, with the process of malting?—I know something about it.

6865. We have had it stated in evidence before us here that the south country maltsters almost all use anthracite coal?—Then their beer will be undoubtedly purer.

6866. The London beers have not been found to have arsenic?—That accounts for it, but at the same time as I have shown you even in anthracite there is more arsenic than will now be passed, and it can be removed in the same way as the arsenic from worse fuel, viz., by brushing and polishing the malt.

Arsenic in
anthracite,

6867. I suppose that care taken in the selection of the coal would almost do it?—I do not think you will find any anthracite quite free from arsenic. What I examined was about the minimum you will find; it was a very good anthracite indeed. There is always a little pyrites, and it comes from the pyrites. Of course, we are now much more critical than we should have been before.

6868. Is it not the case that gas coke is apt to give a disagreeable flavour to the malt, so that you cannot use a very large quantity of it?—I am told that the public will have the fuel dried malt, and will not have beer made from malt dried by hot air and not by fuel, either coke or anthracite. That is what brewers and maltsters alike tell me.

6869. It has been given in evidence before us that if you use gas coke exclusively for your fire below the malt, it gives a disagreeable flavour, and that you cannot very well use pure gas coke?—I hope that is true, but I have not come across that fact.

6870. That might account for a very variable amount, according to the proportion of gas coke which was mixed with oven coke?—Certainly.

And in coke.

6871. You would agree with the evidence given before us that oven coke is less likely to contain arsenic than gas coke?—Yes, the figures I gave you were for oven coke, and they were from a very special quality of oven coke, that is limited in quantity and used only by the best maltsters, but even there there is a trace of arsenic which requires to be brushed off. I insist upon brushing now, and the maltsters are rapidly adopting the brushing process.

6872. I think I understood you to say in one specimen

of malt you examined there was 1-12th of a grain per pound before brushing, and that after brushing thoroughly there was only 1-80th of a grain per pound?—Yes; after the third brushing there was 1-80th of a grain.

6873. That points to the fact that screening and brushing, if carried out thoroughly, will almost entirely remove the contamination of arsenic?—Quite so. Screening alone is not enough, but screening and brushing is enough.

6874. You say here that it is absolutely essential, as I suppose we should all agree, that the Legislature should provide some simple and efficient means of fixing the standard of arsenic and other things, and unless that is done there will be a great deal of useless litigation and want of uniformity. For practical purposes, what quantity of beer do you think should be taken for examination?—I ask now for a Winchester half-gallon, and I like to employ for the quantitative process a litre and a half, that is about one third of a gallon.

6875. So that a Winchester half-gallon gives you about 4½ to 5 litres?—It is over 2 litres.

6876. A sample has to be divided into three parts, so that a larger quantity would be required?—They now ask for a gallon and a half, but where they cannot well get that for various reasons, they take a gallon, and we can do with the gallon. One part goes to the vendor, one is retained by the inspector for production in Court, and one comes to the analyst, and from that one-third of a gallon I can do all that is necessary, but with the smaller quantities of arsenic I like more if I can get it.

6877. Do you think that is sufficient almost for practical purposes?—Half a gallon is ample for practical purposes.

6878. (Chairman.) Do you evaporate it down?—For the quantitative analysis I evaporate it down to a quarter of a litre, 250 cc. or thereabouts. That is the concentration of from four to six parts. For the Reinsch's test it is far better not to evaporate at all, and to take a smaller quantity, because in that way you get a more delicate distinction between a small and a large proportion of arsenic in the beer. Moreover, it is objectionable, on the whole, to take the 200 cc. that the Brewers' Committee advised; it is undesirable for the administration of the Act to take that quantity. It is far better to take 50, because every particle of the beer must come in contact with the copper. The copper does not extract arsenic from a portion of the beer a little distance away from it. It must be in contact. There is no attraction like the magnet for iron. It takes far longer, and there is more chance of underestimating if you have a larger quantity of the beer. Their method was employed for their purposes, because they wanted to fail to find a small quantity, which would be passed as not worth bothering about. But the public analyst ought to be more precise than that.

6879. (Sir William Church.) I should like to know your opinion of what has been stated before us by some in water witnesses that the Reinsch test acts better in beer than it does in water, that is, that the arsenic is deposited more rapidly on the copper in a solution of beer than it is in water?—I do not find that. I can believe that the arsenic may begin to be deposited earlier in the beer in some circumstances, but the later portions of it will not be deposited so quickly, and probably will not be deposited at all. You fail probably to find the whole. Certainly it does not come down so well at the finish.

6880. (Chairman.) In respect to the quantity used, surely the Reinsch test would not lose any sensibility by using double or treble quantities of the beer boiled?—It is apt to do so if you do not boil sufficiently long.

6881. I think your answer confounds two distinct ideas. One is getting all the arsenic out of the beer, and another is getting as much as the beer can show on the copper. If you take a gallon of beer and boil it according to the Reinsch with a piece of copper of a given size, you would get rather more on the copper than if you only take 50cc. ?—Yes, but you do not want to get so much as that.

6882. You want the test to be as sensitive as possible?—If you get a large quantity which is a small fraction of the whole, from a large quantity of beer, that is not so good a result as getting nearly the whole of the arsenic from a smaller quantity of beer.

6883. Then for that purpose the test should be continued, a first piece of copper and a second?—Yes, and

Dr. J. C.
Brown.

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Need for
official
standard
regards
arsenic in
beer

Quantity
beer required
for purpose
of F. and
Acts.

Degree of
delicacy.
Expert
Committee's

Reinsch's
test in water
compared.

Quantity
beer needed
for Reinsch
test.

7. C. a third, fourth, and fifth, until you have exhausted the arsenic in the beer.

1901. 6884. If that is done there is reason for the smaller quantity?—If that is done the larger quantity will be no disadvantage, but when to save time you do not do that, the smaller quantity is better.

6885. If you are not going to take all the arsenic out of the beer by the Reinsch test, then the larger the quantity of beer used the better?—Yes.

6886. So that it would be better to use 100cc. than 20?—Yes, but not if you are going to make it an approximately quantitative process. If you are going to guess the quantity it is better to take the small quantity.

6887. That is to say if you continue it until you take it all out of the beer?—That is what I meant.

6888. But then, on the other hand, the quantities you get out will be too small to be perceptible. If you want to make a really exhaustive test you should take a large quantity and continue it. Every part of the beer comes in contact with the copper?—Yes, but I can find a real 1-100th of a grain per gallon by 50cc., and that is delicate enough.

6889-90. I am simply questioning the idea that under any circumstances a smaller quantity is more favourable for the Reinsch test?—I do not wish to press it. I prefer 50 now, having worked with 200 for two or three months. I prefer the 50 as the result of experience, when I wish an approximately quantitative result, not otherwise.

6891. Do you know what others use?—200.

6892. Others do use the larger quantity?—Yes, and I have come by experience to prefer the 50; the reason being this, that we get more certainly the whole of the quantity out, and a man who is in a little hurry and does not take a second piece of copper will miss some of the arsenic in the 200, and I will get the whole from 50, and the whole from 50 is better than a fraction from 200.

6893. But nobody, as a rule, continues the test until he has secured that the whole is out?—I think he ought to.

6894. That is an important point, but it is not done according to the rule that has been given as having been resolved upon by the experts who reported for the brewers?—I know, but they did not wish to find very small quantities. That is why I mentioned it here, and I think it is important, because the whole value of the test beyond their particular object is getting as nearly as possible the whole out of a certain fixed quantity of the beer. We do not want to get a large, but unknown, fraction of the whole, but as nearly as possible the whole.

6895. Then, I understand and see the rightness of your view. When you get, too, such small quantities that there is a great difficulty in weighing them, then clearly a larger quantity of the material gives you a surer result?—Yes, but for my weighing process I do not use Reinsch at all. For my weighing process I use the extraction by Fresenius method destroying the organic matter, and for that purpose I want as large a quantity as possible.

6896. (Dr. Whitledge.) You found selenium in Nicholson's acid?—Yes, in all the samples I found it.

6897. Did you notice anything peculiar about the colour that suggested selenium?—No.

6898. It is not necessary then for a characteristic colour to be assumed when selenium is present?—No, because the selenium is there as selenious acid, and that is not coloured. It is selenium element that is coloured, or the sulphide. I am glad you mention that, because I have brought up an interesting specimen of selenium. (Specimen shown.) That is a specimen of selenium got at the Glover tower.

6899. (Sir William Church.) Is this from Bostock's acid?—No, that is from a good works. I did not know before that selenium was got at the Glover towers, but I am told it is skimmed off the acid.

6900. (Dr. Whitledge.) As an ordinary source of selenium?—No, it is not yet utilised, I believe. It is elementary selenium.

6901. As a fruitful source of selenium?—It varies with different ores. It is not found in the flues of some works. I have always failed to get any in the flues, but it is got in the Glover towers. As the fumes go up in the presence of plenty of sulphur di-oxide, the

sulphur di-oxide reduces any selenious acid to the elementary form, and the dilute acid coming down washes that solid selenium out, and it floats on the acid at the bottom. A little is also got in the chambers, but much less than at the towers.

6902. Then one would expect to find selenium ordinary in sulphuric acid unless it has been removed by purification?—In some sulphuric acid, not in all. The acid is spontaneously purified by the sulphur di-oxide in the Glover tower, and the process of purification is merely perfecting in another tower what has been already begun.

6903. And the purification intended to remove arsenic would at the same time remove any remaining selenium?—There are several methods of removing arsenic, but the best one will also remove selenium.

6904. What method is that?—Treatment with sulphuretted hydrogen in a tower, like the Gay-Lussac tower.

6905. That removes the selenium?—Yes.

6906. Have you any reason to think that analytic results from the same barrel of beer may be affected by whether a sample was taken from the upper or the lower part?—You are thinking of a piece of evidence that was given by some other analyst to Dr. Sergeant, and I cannot go so far as he did. But there is this foundation for it that I have found very clearly, that there is relatively much less arsenic in cases of slight contamination, after the beer has been racked and the finings added than there is in the original vat in which it has been brewed. The quantity is less when the beer is finished. I have traced that to the small quantities of solid matter, finings, yeast, and other things that are more highly arsenicated than the liquid. I have come upon the further fact two or three times, that that same beer which was better after it was racked than when it was in the vat has apparently lost almost the whole of its arsenic some weeks afterwards when it has been sold in the public-house—I chanced to follow the same beer—and I can only attribute that change to the settlement of minute solid particles of the yeast, malt, and finings. They throw a handful of hops into the barrel, and when that settles it takes a little out. When the quantity of arsenic is large I have found the arsenic in the hops and sediment, but I could not make out that it was greater in the solid matter than in the liquid, and therefore did not sensibly purify the beer. No doubt it is a means of purification, when the quantity is sufficiently small, and that is partly how I account for malt slightly arsenicated yielding absolutely free beer.

6907. (Chairman.) Is there not a danger in the casks? Will not it go on depositing until there is a considerable quantity in the casks?—Every cask that goes back to the brewery is carefully purified by water, soda and steam successively, and there is not a trace of arsenic left after these processes. I have tried that. I have a sample I should have put in before, when speaking of Bostock's acid. A quantity of liquid sulphuric acid equal to the total liquid in that bottle yielded the amount of arsenious sulphide which is in that bottle. (Specimen shown.)

6908. What is the liquid?—It is water, but it shows the bulk of the 11 grammes of acid that I took, and the precipitate there is the sulphide of arsenic obtained from it.

6909. This selenium I see is marked as being from the Glover tower?—Yes.

6910. Where was it found?—It was skimmed off the acid at the bottom of the tower.

6911. Skimmed as the scum off the acid?—Yes. Bostock's acid we believe to be the acid from the bottom of the Glover tower. That is the selenium skimmed off similar acid from another works.

6912. In these other works, did that selenium get into the acid in large quantities?—It could not be perceived. I failed to find it.

6913. Although it existed in that scum to skim it off, there was not enough in the acid to show at all?—The sulphur di-oxide in the Glover tower precipitates it all as elementary selenium, and it is skimmed off in that form, and never goes out. Besides, nobody ought to sell Glover tower acid.

6914. What is done with the Glover tower acid?—It is used up again for other purposes of purification.

6915. (Dr. Whitledge.) You told us just now of the divergent results obtained in the analysis of one par-

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Purification of sulphuric acid from arsenic will also remove selenium.

Beer may lose arsenic on keeping

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ticular sample; that you obtained 1-9th, and Dr. Stevenson something which, after allowance, came to 1-7th, and other results were widely different?—Mr. Jones also got 1-7th.

6916. And Somerset House only found 1-100th?—Yes.

6917. Do you regard those results as satisfactory for the purpose of a court of justice?—They are unsatisfactory, but I think there would have been a conviction; my dishes would have persuaded the magistrate, I believe.

6918. But as a matter of fact, different methods were adopted, and they led to divergent results, which divergent results would have been before the court who had to decide?—They would have been before the court.

Destruction
of organic
matter
should be
essential to
any official
test for
arsenic in
beer.

6919. In the light of that experience and others of the same kind, would you say there ought to be some agreement as to the uniform method of analysis?—To a certain extent there ought to be an agreement, and I should be perfectly satisfied with the destruction of the organic matter before starting the process of estimating and an absolute weighing of the arsenic in some form.

6920. You would be in favour of as much uniformity as possible, but you regard the preliminary destruction of the organic matter as essential in any satisfactory method?—Yes; there are two or three methods after that, and I would be content with any of them. One man might be more expert with one, and another with another.

6921. You speak of some samples as showing such very minute traces as to be considered "genuine." What sort of a standard have you in mind?—I should not like to say that any beer containing less than 1-100th of a grain per gallon was other than genuine.

6922. You would return a beer containing less than 1-100th as genuine?—Yes, I think so.

6923. In an official certificate?—I think so.

6924. Would the medical officer of health or whoever receives that certificate understand from that that it was absolutely free?—None of the medical officers that I have to do with would, because I have told them it does not always mean that.

6925. I think one of them drew the conclusion that it was entirely free. When you use the term genuine, you do not mean it to be inferred it is entirely free from arsenic?—I mean that it is practically free.

6926. You have a reservation; you do not mean absolutely free?—No; there is no beer in which I could not get a couple of crystals if I evaporated down a sufficient number of gallons.

As public
analyst
advises as
to selection
of
samples
under F. and
D. Acts.

6927. Did you advise the authorities by whom the samples are taken as to the selection of samples and the quantity of samples?—Yes, sometimes; it is my duty to advise them.

6928. The Corporation of Liverpool and the county authority of Lancashire?—Yes; but they are not obliged to follow my advice.

6929. You are consulted?—Yes. When I was first appointed, 23½ years ago, the Corporation of Liverpool through the Health Committee told me to advise and instruct the inspectors, and that is still my duty. Since Dr. Hope became Chief Inspector—when he was

made Medical Officer of Health he was made Chief Inspector—he has required much less advice.

6930. But you do confer with Dr. Hope?—Yes, by telephone nearly every day. The county authorities, when they appointed me in 1875, also clearly instructed me to advise the superintendents, and particularly to tell them in each case, whether the certificate was such as to indicate clearly an offence or not. That is still my duty.

6931. If you became aware of any danger to public health arising out of such a matter as arsenic in beer it would rest with you to advise that samples be taken?—It would not be my official duty to do it, but I should be expected to do it, and I should certainly do it.

6932. Have you received instructions from the Local Government Board of any kind?—Not from the Local Government Board.

6933. You make an annual and quarterly report to the Local Government Board?—I make a statutory quarterly report to every authority for which I act, and a copy of that has to be made out by their office and sent to the Local Government Board.

6934. So that you have no official communication with the Local Government Board?—Not directly. But they send me a copy of their annual reports, and get copies of my quarterly reports.

6935. Are you in official relation with the Government laboratory?—No.

6936. And neither from the Government laboratory nor the Local Government Board have you received any official instructions?—No. I should prefer not to receive instructions from them. We have had private communications, and comparing of notes occasionally for mutual benefit, which has been very useful. There are a number of details in the reports that have been handed to you by Dr. Sergeant and Dr. Hope which are not quite correct, partly through clerical errors, no doubt, and partly because my first returns were made upon the very rough qualitative estimation not intended to be for the purposes of the Act: "a small quantity," and that sort of phrase was used. It was after the first quarterly report, before I had better estimates, and therefore the medical officers have not in all cases got the better estimates. I have prepared clear details of the whole for the different authorities, which you might like to have, and which may be more reliable than what you received from them. (Document handed in.)

6937. (Sir William Church.) Shall we be able to identify these with the tables we have already got?—I think so. I have put them in such a form as would do that. In addition, there is the Borough of Preston, which they do not know about; there is the Borough of Blackburn, for which Mr. Collingwood Williams acts; and there is the Borough of Barrow-in-Furness, for which he also acts. The Borough of Bootle, for which we both act, had all its beers so purified by the action of the city authorities that they never found any arsenical beer. (Documents put in.)

6938. (Chairman.) I understand you have some suggestions to make to us as to administrative questions, which you will send to Dr. Buchanan for incorporation as an Appendix?—Yes. (See Appendix No. 15, p. 362.)

J. C.

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FOURTEENTH DAY.

AT WESTMINSTER PALACE HOTEL.

Saturday, 4th May, 1901.

PRESENT:

The Right Hon. LORD KELVIN (*Chairman*).

Sir WILLIAM CHURCH.

The Right Hon. Sir WILLIAM HART-DYKE.

Dr. WHITELEGGE.

Mr. COSMO BONSOR.

Dr. BUCHANAN, *Secretary*.

Mr. THOMAS WATSON LOVIBOND; called and Examined.

W. 6939. (*Chairman*.) You have held the position of
nd. managing director to the Newcastle Breweries for 11 or
12 years?—Yes.

1901. 6940. Is that a large trade?—Yes, a very large busi-
ness; involving nearly two millions of money and two
hundred thousand barrels a year turnover.

6941. You were chairman during two years, 1899 and
1900, of the Country Brewers' Society?—Yes, I vacated
the chair in December last.

6942. And you are Fellow of the Institute of Chem-
istry, and worked formerly under Dr. Graham in Uni-
versity College, London?—Yes.

6943. You have practised and supervised in brewing
operations for thirty-eight years, and are acquainted
with the manufacture of every class of beer?—Yes.

6944. I understand, with the great experience you
have thus had, you wish to endorse what has been told
us about the desirability of using sugars and other
adjuncts in brewing?—Fully; I look upon them as a
practical necessity for modern brewing—an absolute
necessity.

6945. Is it your opinion that these adjuncts are an
advantage to the brewer?—If the adjuncts are properly
chosen they improve the quality of the beer, and in
some cases effect economy, but not so much in all cases.

6946. But you consider they improve the quality?—If
they are properly chosen—decidedly.

6947. An incidental advantage is the shortening of
the time needed to brew?—That is my own experience.
I have been able at Newcastle to turn out good light
beers in very much less time than was the custom of
the trade formerly, under a fortnight a great deal of our
beers, and three weeks the longest, and of course the
advantages to me are considerable. I have been able
to make a cellarage accommodation serve now for three
times the trade it served for twelve years ago.

6948. In your view and the view of your Society, if
adjuncts were prohibited, more foreign barley would
have to be used?—Unquestionably. Foreign barley is
the one substitute that we can look to in the ab-
sence of what are commonly called adjuncts. English
barley, except the very finest, is not fitted for use
entirely by itself.

6949. The British barley grower, we understand in
your view, would not benefit by the prohibition of
brewing sugars?—I do not think he would.

6950. Speaking on behalf of the trade, you would
welcome any recommendation which would safeguard
the public against any possible contamination of beer—
for instance, by arsenic?—Certainly I would—any
recommendation which would safeguard the public would
protect the brewer as well.

6951. Whether introduced in the malt or by brewing
sugars?—Wherever it comes from, if it can be safe-
guarded it will be a protection to us as well as to the
public.

6952. Can you tell us how many brewers there are in
England and Wales apart from publican brewers?—I
cannot give you any figures later than September, 1899,

and in that year there were about 6,796 brewers alto-
gether, and a large proportion of those, very nearly
5,000, were practically publican brewers; so that the
brewers of any importance were only some 1,800. Of
those 300 are small, the general result being that there
are only some 1,400 brewers of any importance.

6953. Brewers other than publicans?—Yes, in Eng-
land, and of those very nearly half are members of our
Society. My reason for wishing to state this is that
statements are being constantly made, and Mr. Chaplin
himself in the House made a similar statement, to the
effect that the great majority of the brewing trade do
not use adjuncts, and that, of course, was intended to
convey the impression that the use of adjuncts is in
the minority in quantity, whereas it is only in the
minority in number of brewers. The 5,000 publican
brewers, who, of course, are a very large proportion in
number, only use 3·8 per cent. of the total brewing
materials used in the Kingdom. They are a perfectly
insignificant minority, and do not in any way repre-
sent the brewing trade.

6954. Do the publican brewers use brewing sugars?—
To a very small extent.

6955. (*Mr. Cosmo Bonsor*.) Those are the Excise sta-
tistics?—Yes. I have put in fuller papers in sending
my proof to Dr. Buchanan, but they are public figures.
There is nothing at all that cannot be got at in the
ordinary way.

6956. (*Chairman*.) How many brewers to your know-
ledge use no malt adjuncts?—I could not say that. You
may safely take it that a great proportion of publican
brewers, the small brewers, use none, but of the
balance, the important brewers, I should say there are
very few indeed who use none, but I could not give you
figures.

6957. Are any of the publican brewers members of
the Country Brewers' Society?—No, they would scarcely
be eligible. The Country Brewers' Society is supposed
to represent the wholesale brewing trade of the country,
not including Burton or London, and one or two other
important districts, such as Manchester, where they
have their own large and important societies, indepen-
dent of the Country Brewers'.

6958. Can you give us a statement of the action taken
by the Country Brewers' Society with regard to arsenic
in beer since November 24th, 1900?—Yes. I give that
statement with a view to showing that the Country
Brewers' Society was as active as possible in facing
this difficulty, and in warning its members of the arsenic in
danger that had arisen very unexpectedly. The first
intimation was on the 24th November, when I saw
two paragraphs in the North Country papers to the
effect that there had been arsenical poisoning on the
western side of the Northern part of England. I sent
those paragraphs at once to the secretary. At that
time I was chairman. The secretary, on the 28th No-
vember, interviewed a reporter from the "Daily Tele-
graph," and on the same day a meeting of the Parlia-
mentary Committee of the Society was held, and on the
following day, the 29th November, a letter from the
secretary appeared in the "Times," asking the public to

Mr. T. W.
Lovibond.

4 May 1901.

Many
brewers use
no adjuncts
to malt, but
their output
is small.

Action by
Country
Brewers'
Society on
discovery of
arsenic in
beer.

Mr. T. W.
Lovibond.
4 May 1901.

suspend their judgment until the facts were better known. On the same day a circular was issued to the members of the Society, warning them that no sugars should be used in brewing unless they had been examined for arsenic. That circular is, I believe, the first circular of any public nature which was issued to any large number of the brewing trade on this subject. I believe that it was issued simultaneously with Messrs. Bostock's telegram to their own customers, but it was issued prior to Messrs. Bostock's circular in which they explained more fully, and asked that their materials should not be used. On the 30th another meeting of the Parliamentary Committee was held, and another paragraph was issued intended to allay alarm. On the 3rd December the matter was considered by the General Committee of the Society, and the steps taken up to that time by the Parliamentary Committee were approved. On the 13th December the General Committee met again, received a further report from the scientific advisers, and ordered that another circular, marked "C," advising examination for arsenic of all descriptions of glucoses, invert sugars, priming sugars, and caramels, and urging that facilities should be given to local authorities, should be sent to the members. On the 19th December a circular, marked "D," was issued to the members of the Society, quoting Mr. Estcourt's warning as to the presence of arsenic in malt, and again advising care. On the 21st December copies of the report (marked "E" in my papers) of the Commission of Experts appointed by the Manchester Brewers' Association (Appendix 5), and of Dr. Dupré's letter to the "Times" of December 21st, were issued to the members of the Society. On the 9th January, 1901, the Parliamentary Committee met and again discussed the matter. On the 25th January, at a meeting of the General Committee, the advisers reported additional facts, and certain points were referred to the General Purposes Sub-Committee for inquiry. On the 7th February the General Purposes Sub-Committee met. On the 15th February they again met, and the General Committee met and received a report from the Sub-Committee, and the further circular, marked "G," dated February 15th, asking for particulars of any proceedings which were being threatened against members, was issued to the members. We have also distributed Dr. Buchanan's report to the Local Government Board. Extracts have been issued to all members.

6959. The Society kept a close watch on the developments of the subject?—I think you may take that—probably the closest of any public body connected with the trade.

6960. Who are the scientific advisers of the Society?—Dr. Moritz and Dr. Morris.

6961. Dr. Buchanan informs us that he was in error in saying in a foot-note to his report to the Local Government Board that a circular sent to the members of the Country Brewers' Society cautioned them against Bostock's sugar, the fact really being that members were cautioned against the use of any brewing sugars which had not been first examined for arsenic, and that he would like this put right?—Yes. Our first circular was issued on the 29th November, and it did not mention Messrs. Bostock's name. At that time Messrs. Bostock's name was scarcely public property, and we did not desire to mention any firm by name. But we did issue that circular six days before the issue of the Manchester expert's report.

6962. Dr. Buchanan states that he has informed the Brewers' Society that this would be corrected in any further issue of his report?—I shall be very much obliged. We should be glad that this slight inaccuracy in the report should be corrected so as to set the Society quite straight before this Commission and before the public generally.

6963. In respect to action taken with regard to arsenic by your own firm?—I think on that subject I had better perhaps tell you exactly what I have done. As soon as our fears were aroused by the knowledge of what was taking place elsewhere, I had analyses made in my own laboratory by our head brewer, who himself is a perfectly competent chemist, for arsenic, of all our materials and all our products—very carefully done indeed; and the result was that we found no arsenic whatever existing in any one of these materials or products excepting in one instance. In that instance the amount of arsenic found was definitely perceptible, but it was exceedingly small; it would not be more than 1-20th of a milligramme of arsenic in 5 grammes of the dust.

6964. (Sir William Hart Dyke.) Malt dust?—Yes, but I must explain what kind of dust. The substance in which we found this minute trace of arsenic was not the malt culms—or combings as they are called in some parts—that is to say the rootlets of the growing barley. In that we found none, but the dust in which we did find a trace was the very fine dust which is rubbed off the malt, and which is exhausted from the malt before grinding by means of a fan, and carried to a chamber. In 5 grammes of that dust we found 1-20th of a milligramme of arsenic or something under. I need hardly point out that that dust is a very miscellaneous sort of substance. It is partly soil, partly spores of all kinds of organisms, and tiny bits of the skin or husk of the malt. It is a very mixed product which in our case does not go into the beer at all. It is extracted by the malt fan and removed before the malt is ground. One material of which I had my doubts was very carefully examined, and that is the coke we use for drying the malt. We do not use anthracite coal in the North of England, the freight being very heavy; it is costly. We use coke, and it has been the practice with my company to use the best oven coke we can get. It is the Mickleby Coal Company's coke, and we did not find after many examinations of this coke that there was any arsenic present. It is a very high-class coke, an oven coke and not a gas coke. Gas coke is more or less a suspicious subject. It is a coke I never would have used and never have used.

6965. (Sir William Hart Dyke.) Did you ever use gas coke?—Gas coke probably still is used in some parts of the country, but I have never used it because I know the risk and dangers of it.

6966. (Chairman.) Did you know the risk of arsenic in coke before this recent epidemic?—As a chemist I knew it perfectly well; as a practical brewer it had never been brought before me in such a way as to make me think it necessary to search for arsenic.

6967. The malt to which you referred as having found a very small trace of arsenic in the dust was malt made by yourselves?—Yes.

6968. Do you make all your own malt?—Not quite. We buy probably 1-5th of our consumption.

6969. Have you tested any of the malt you bought for arsenic?—Since the trouble in November last we have only bought malt from a firm in Newcastle, and their malt has been tested and found as satisfactory as our own. Their practice is the same as ours. They use a high-class oven coke for drying.

6970. Have you tried more than once to find whether there is any arsenic in the rootlets?—Yes, several times, and we have not found arsenic in the rootlets. I ought to explain that in the process of aspirating the real *bona fide* dust to which I have referred, the rootlets are left in a very much cleaner condition than they would be if the malt was screened as a whole. The screening and grinding are conducted in one operation, the small dust is aspirated out by the fan, but the malt culms are dropped through the breeze of the fan, and are gathered in a separate place, clear of the fine dust.

6971. Is the clearing away of the fine dust done after the rootlets have been knocked off?—After they have been knocked off, but at the same time as the whole malt, culms, dust, and everything are dropping down towards the mill.

6972. You draw away the fine dust?—Yes, by a fan.

6973. And the fan would not carry the rootlets away?—No, the rootlets go in one direction, the malt in another, and the dust in another.

6974. We understand from the statement we have before us that you can and do produce beer in which no arsenic can be detected in a half litre?—Quite so. We have attempted many of our experiments on the full half litre instead of on the 200cc. recommended by the committee of experts who reported to the Manchester brewers.

6975. By what test?—By the Reinsch test.

6976. How much copper have you used, and how long a time for boiling?—The quantity of copper is not essential; we use a small piece something under an inch square.

6977. Each side was coated?—There would be two sides, arsenic free copper gauze, and the time would be somewhere near an hour.

Mr. T.
Lovibond.
4 May
Not a trace
found in
malt cul

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in malt.

Oven co
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malting

Screenin
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and dust

No arse
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half a li
of their

Action by
Newcastle
Brewery
Company.

T. W. 6978. Have you ever put in fresh copper and continued the boiling for another hour?—Yes; we have done that; we have carried on some of our experiments for a very long time, two or three hours with the view of seeing if that would give a different result, but we have not found arsenic.

6979. Have you found arsenic in any case?—In no case at all except in the case of this fine malt dust.

6980. In the case of the malt dust you perform the test in the same way by boiling?—No, that would not be conducted in the same way; that would be digested with nitric acid and sulphuric acid, and then the product washed out and treated by the Marsh test.

6981. In the case of malt, what quantity has been found free from arsenic by Marsh or Reinsch tests?—We have taken from 5 to 10 grammes; generally 5 grammes, but some of our experiments have been done on 10.

6982. What adjuncts do you use in your brewery?—I have not used glucose for a good many years. The adjuncts I have used and am now using are inverted cane sugar and maize grits.

6983. The maize grits are converted by the aid of sulphuric acid?—No. On that point I may mention that for many years I inverted my own cane sugar by the aid of sulphuric acid. Not with any view of avoiding arsenic, but with the view to keep an exceedingly unpleasant and difficult material to handle like vitriol out of the brewery, I some years ago adopted the process of inverting the cane sugar by means of yeast, a simple and admirable process which inverts cane sugar in exactly the same way as acid, but in which the agent employed is brewers' yeast. That has been my method for some years past. In the case of the maize grits, there the conversion is the purely natural diastatic conversion in which the agent is the diastase of malt and the product made is not the glucose of sugar manufacturers, like Bostock's and others, which is mainly dextrose, but it is the natural substances always obtained in the mash tun, viz., dextrin and maltose.

6984. Does that give the same result in brewing as inverts prepared from sugar?—It is not to be compared with invert prepared from sugar, because the products are different, but it is to be compared with the glucose, mainly dextrose, made from grain such as rice or maize. But whereas the glucose manufacturer produces an article mainly dextrose, easily fermentable, the conversion by means of diastase produces a wort composed of maltose and dextrin, which are the natural substances produced by diastatic conversion of malt itself.

6985. With respect to the brewing the beer, is it nearly the same whether you take the glucose or invert made by sulphuric acid, or whether you take invert made in the manner you have described?—No, the results are widely different. In the case of grain, more particularly maize grain—I do not say quite the same of rice—but in the case of maize the results by our mode of conversion are vastly superior to the results obtained from acid made glucose.

6986. In what respect superior?—In respect of fullness of the resulting beer, and in flavour. I think those are the two main points. The beer is fuller, and the flavour is better.

6987. In respect to alcoholic result is it the same?—I should think theoretically you would get a little more alcohol from the sugar makers' glucose than you would from the corresponding quantity of grain. I think there would be a little difference inasmuch as the dextrose of the sugar maker is a more fermentable substance than the mixed sugars that are produced by the diastatic mode of conversion in the mash tun.

6988. What you call the "diastatic mode" is conversion by yeast?—No, I mean a mash tun conversion. Diastase is a soluble ferment, to use a simple expression, which is produced naturally. In barley malt that diastase has a convertive power which acts not alone on the starch and sugar materials of which the malt consists, but on all other starch or sugar materials presented to it under proper conditions, and we make use of this diastatic power. I think I ought to explain that the yeast conversion which is in your mind, and to which I referred just now, is a totally different thing. That is not a conversion of starch into malt sugars, which is the mash tun process, but a conversion of cane sugar into invert sugar which is not a mash tun process. The latter is done outside the mash tun, and there is no connection between the two processes.

6989. (Sir William Hart Dyke.) It is added afterwards?—Yes, the invert sugar is added in the copper after the mashing.

6990. After that process is over?—Yes.

6991. (Chairman.) How do you conduct the inversion of cane sugar by yeast?—It is a question of temperature. The cane sugar is first dissolved in boiling water. The hot sugar solution is cooled down to the proper temperature, the temperature of maximum invertive power or activity of the yeast, a proper proportion of yeast is added, and it is a mere question of time for the yeast to effect the complete inversion of the cane sugar into invert sugar.

6992. If that process was allowed to continue, alcoholic fermentation would take place?—No. The temperature at which it is done is not a suitable temperature for fermentation. In fact the yeast which is used for inverting the sugar is killed so far as its fermentative or alcoholic producing power is concerned.

6993. You do not first treat the yeast in any way?—No.

6994. At what temperature do you conduct this inversion process by yeast?—About 130 to 135 F.

6995. And the fermenting temperature is much lower?—Yes, from 54 to 75 F. in this country. It would not go on at the higher temperature of 130.

6996. You use the word with reference to the maize, "maize grits"; how is that produced?—That is produced mainly in America by purely mechanical means. The maize grain is decorticated, and then run through machines, and attacked by means of knives, which cut out the germ of the grain, and the germ of the grain is that part which contains nearly all the oily matter of the maize, most of the albuminous matter, and practically all that portion of the albuminous matter that is soluble. The remainder is ground between rollers into pieces about the size of large pin heads. The fine starch dust which arises in the process is carefully taken out and used for other purposes, and the grits sent to us consist of nothing but the pin head size bits of the starchy matter of the grain.

6997. And contains none of the oily matter?—Practically none of the oil, and practically none of the soluble albuminoids.

6998. (Mr. Cosmo Bonsor.) There is no chemical used in the process?—No, it is entirely mechanical.

6999. (Chairman.) Does that separate entirely the germinating portion of the maize from the remainder?—Yes, it separates the germ entirely.

7000. Would it be correct to describe maize grits as starch?—A very pure form of starch indeed, considering it has not been purified by any manufacture.

7001. You get it so pure it gives no disagreeable flavours?—No, and our flavours are improved, which could not be said of many forms of raw grain.

7002. Is it by fans that the maize is separated into two parts?—I have never been through an American mill, but I should think it was rather done by screens than fans; it is bound to be done by screens. Fans would not give the clean dust-free product we require.

7003. Do you buy any of your adjuncts beside the maize grits?—That comes from America.

7004. Have you had occasion to require any guarantee with reference to the quality of the maize grits?—No, we buy by sample, and if it comes according to sample we are perfectly satisfied. From the point of view of arsenic I do not consider there is the least necessity to require a guarantee as regards maize grits. We found in have examined them, but we did not expect to find, and them. did not find any arsenic.

7005. Do you buy any other adjunct?—Nothing but cane sugar. That also is an article which I believe is above suspicion—unless it is treated with arsenicated acid.

7006. We are to understand then in your own brewery you have never used sulphuric acid?—Yes, some years ago, but I gave it up.

7007. And you never use it now?—No, and have not done so for some years.

7008. Did you give it up for anything deleterious, or only from inconvenience?—I gave it up because I looked upon it as a dangerous and unpleasant material to handle—a splash in the eye will deprive a man of his eyesight. I had two or three accidents; I gave it up because I found a better method.

Mr. T. W. Lowbend.

4 May 1901.

Inversion of cane sugar by yeast.

Preparation of maize grits.

Objection to use of sulphuric acid in a brewery.

Mr. T. W. Lowboud. 7009. The method you practise you found also fairly economical?—More economical than acid, because my yeast costs me nothing, and my acid did cost something, although it is a cheap substance.

7010. So that you use what you find and believe to be a safer and better process, and yet not a more costly process?—More economical, in fact.

7011. In the general way you still approve of the use of what are called brewers' sugars?—Certainly.

7012. Although you do not use them yourself?—I have no fault to find with them. Other brewers find them useful, and I know they are useful. They come under the general principle of useful adjuncts. In my opinion glucose is not so useful an adjunct as invert sugar, but that is a matter of opinion in which some brewers differ from me, and they find glucose a useful material, and it is one of that class which I consider essential materials to be used for modern brewing.

7013. You would rather not use sulphuric acid yourself, but if the users of brewers' sugar find it advantageous you do not disapprove?—Not at all, because the brewers' sugar makers remove the vitriol.

7014. And they take upon themselves the arrangements to prevent inconveniences from such a dangerous material?—Yes, and they ought to take upon themselves the risk.

7015. It must be found economical by them, and by some brewers to use sulphuric acid in that way?—Yes, it is economical, undoubtedly. The acid process is practically the only one available for manufacturers who manufacture on a very large scale. I do not think the yeast process would be practicable, or applicable to the enormous scale of the sugar manufacturer.

Tied house system facilitated with-
drawal of
arsenical beer
from
publicans.

7016. You have some remarks to make with regard to the tied house system in relation to the epidemic?—I should like to point out that much as the tied-house system may be abused, I believe that in this case it has been a very great deal of assistance throughout this trouble in the Manchester and North-Western district. If it had not been for the absolute power of control which the brewer has over his tenant and customer in the matter of his stocks and so on, instead of these beers being promptly condemned, and carted back to the brewery, and taken out of consumption, as they were throughout practically the whole of the district, the licensees would have had to be dealt with individually. You would have been dealing with a class of men ignorant to a very large extent of the risks they were running and, as has been shown in two or three isolated cases, you would have found objections and difficulties on the part of some licensees to having the beer condemned in a wholesale way. I suggest that the tied-house system enabled the large brewers, like my friend Mr. Groves' firm, to insist upon the prompt and immediate withdrawal of these beers from consumption, and their prompt destruction.

7017. (Sir William Hart Dyke.) You describe two systems, your own and the one more generally used, in each case making adjuncts; in your case by the use of yeast and in the other through the medium of sulphuric acid?—Yes. They only apply as I think I explained to cane sugar. They do not apply to grain conversion. As far as the results are concerned they are identical. It is a mere question of method and time.

7018. Did you adopt this method you have described so well to us, the yeast system, on account of its cheapness, or had you a hidden dread that a catastrophe might happen through the use of a material which might contain arsenic?—I looked upon it as a great advantage to get rid of a dangerous substance like vitriol. I had one or two small accidents from careless men and I did not want to have the responsibility of blinding a man or injuring a man, and I was only too glad to find a process which enabled me to achieve the same result without the use of vitriol.

7019. Apart from avoiding arsenic it was a dangerous stuff to meddle with, and you thought the other process was equally cheap and secure, and would suit you?—In the use of vitriol I was always careful to use good vitriol because I know perfectly well, as most of us do know, that the common vitriol produced for manual manufacturing purposes, contains a great amount of arsenic, and is totally unfit for our use.

7020. You say by the use of malt adjuncts you are enabled to produce a better beer in from 2 to 3 weeks time instead of an inferior article from all malt in about double the time. I want you to tell the Commission something in regard to this newer system—it may not

be called a modern system because it has been going on for a good many years—of brewing through adjuncts instead of the older system by malt. Has this system grown up on account of a change in the taste of the public?—I think you may say that since 1880 the use of malt adjuncts has created a taste for lighter, cleaner beers. The natural result of using these materials was the production of a lighter and cleaner beer that hit the public taste, and that change has been gradually going on for the last 22 years with the result that there is far more of this light clean beer brewed now than there was then, and also with the result that the heavier beers of our fathers' days are brewed far less. They are not so wholesome, there is no question about it, and to me they are not so palatable.

7021. I think you rather criticised the quality of some of the home-grown barley, and I suppose you would wish the Commission to understand that in your trade, apart from the reasons you have just given for the change in the system of brewing, there have been difficulties as regards the qualities of English malt. In some years there is a great difference in English barley, and where an inferior barley is used, adjuncts have to be employed to supply the saccharine matter which is absent?—It is necessary to make some distinction between the various parts of the kingdom. Take Norfolk and Suffolk, where in ordinary good seasons very fine barleys are grown.

7022. Lincolnshire?—Some of the Lincolnshire chalk districts produce very fine barley. There are many districts which produce the very best barley England can grow, and that means as good barley as can be grown anywhere else; but there are other districts, notably my own district, Northumberland and Durham, where our barleys are coarse in nature, coarse in composition, and coarse in their skin, and where it is only in favourable years when we have a favourable harvest time without much wet and so on, that we can use our barleys to any considerable extent. This year I have only bought about a thousand quarters of local barleys; a rival of mine in the trade who is doing an almost equally large business, told his shareholders that he had bought one parcel this season and could not buy any more. Last harvest was an unfavourable one. Other harvests I buy some thousands of quarters of the local barley.

7023. Providing you could get a good sample you have no objection to any home-grown barley?—No; the quality of our malting barleys must be above a certain standard; if the barleys are below that standard it must go for grinding, it is not good enough for us.

7024. (Chairman.) Do you buy much foreign barley?—Yes, a great deal.

7025. You find it necessary?—Yes.

7026. (Sir William Hart Dyke.) You have had 38 years' experience of brewing, and having had a thorough knowledge of chemistry as well, you have been able to go very thoroughly into the causes of this late epidemic?—I think as thoroughly as any other brewer in the kingdom.

7027. As regards your examination of the malt and malt test, you only malt a certain percentage of the malt you use?—70 or 80 per cent. is made at home.

7028. And the balance of course you buy?—Yes.

7029. Will you tell the Commission where you are in the habit of purchasing your malt?—What I call our ordinary malts, that is for the manufacture of ordinary mild beers, are bought generally either from a maltster in Newcastle, a friend and neighbour of our own, or from another old friend and comparative neighbour at Berwick-on-Tweed, where the same class of barley is malted. But if we have to buy fine malts for pale ales we generally go to Newark or some other place where we can get malt made from fine Lincolnshire chalk land barleys or good Norfolk barleys.

7030. When you went through this testing process of the materials you were using, did you test the purchased malt?—At that time we were only buying from one maker, our Newcastle friend, and his malt was tested with the same result as our own.

7031. Both classes were therefore tested, home-made and that which you purchased?—Yes.

7032. Have you ever used gas coke?—No; my knowledge tells me that gas coke is an unfit substance for use for the purpose. It is liable to be too sulphurous, and malting that of course means the danger of arsenic.

Mr. T. W. Lowboud.
4 May 1901.

Light beer prepared with adjunct preferred by public.

Variations quality of English barley.

r. T. W. 7033. Your knowledge of chemistry gave you a whole-
overbond. some dread of gas coke?—Yes.

lay 1901. 7034. Can you tell us from what you have read,
 whether you would consider there was a twofold possi-
 bility of danger as regards malt in respect to the use
 of the fuel, and in not cleaning the malt properly?—
 I should not think there is any material danger from
 not cleaning malt properly provided that the malt
 has been dried with proper fuel. I look upon the
 exceedingly minute quantity of arsenic which I have
 found in our own refuse dust as so immaterial that,
 although we do and have for very many years taken
 the pains to remove this dust, I do not think that the
 risk of arsenical poisoning from it is at all worth con-
 sideration. That was not our reason for removing the
 dust. Our reason was to remove from the malt and
 consequently from the mash tun and the finished beer,
 all, or as nearly all as possible, of the spores, germs
 and other organisms in the suspended condition which,
 if they get through into the beer, would do it harm.

7035. You think the primary cause of mischief and
 danger lies in the fuel?—Where arsenic can be found
 in malt, or beer made from malt alone, I think it is
 quite clear that the source must be the fuel. I know
 of no other source of any determinable quantity.

7036. The process of cleaning is a double process,
 screening and brushing, and there is a fan whereby this
 dust is separated?—That is so.

7037. Therefore there is a double cleansing process
 going on at the same time?—That is so, and that is
 done in most large breweries more or less perfectly
 according to the age of their machinery. The newest
 machinery will be naturally the most perfect. For
 many years past brewers have been devoting their
 serious attention to the thorough cleaning of their
 malt before it is ground.

7038. The only trace of arsenic you were able to find
 was in this dust?—This refuse dust.

7039. In a brewery where this cleaning process
 was carried on, badly and without proper care, this
 separating process might not take place?—That is quite
 clear. In the dust we only found 1-20th milligramme
 in 5 grammes. I do not know what percentage the
 dust is in weight to the whole of the malt, but prob-
 ably not 1-10th per cent., so that you have to apply
 a very big factor before you can bring that quantity
 of arsenic into relation with the malt itself or to a
 pint of beer.

dust
 used for
 ngstock. 7040. I am pressing you on this point on the ques-
 tion of feeding of stock. You are aware, are you
 not, that large quantities of what is called "malt
 dust" is used for feeding stock. Is this malt dust
 that you said in your case is carried to a chamber
 elsewhere, ever used for the feeding of stock?—No,
 there is no nutritive power in it at all. It is dirt,
 dust, and filth of all kinds in a dry or powder form.
 What is commonly called "malt dust" is not dust at
 all in the sense I have been using the word "malt
 dust." Malt dust or malt culms or malt combings are
 the rootlets of the growing barley which are brittle
 after the malt is dried and which are knocked off and
 separated, and we, like all other brewers, sell that for
 the purpose of feeding stock, sheep more particularly.
 That I have found to be free from arsenic as far as our
 brewery is concerned.

7041. Are you aware that evidence has been given
 before this Commission whereby a very large quantity
 of arsenic has been found in what a witness termed
 "malt dust" which had been accumulating for many
 months in a kiln? I suppose under no circumstances
 such dust as that could be used for the purpose of feed-
 ing stock?—I would not like to say it could not be
 used for the feeding of stock, but I should say that
 the malt combings which accumulate underneath the
 tiles would be a very poor food and very unlikely to
 be used for the purpose. Where arsenic has been
 found in these malt combings or rootlets I think you
 will find that that will be concurrently with the use
 of an inferior fuel. If an arsenical fuel is used for
 drying the malt you will find more arsenic in propor-
 tion in the rootlets than you will in the malt; because
 arsenic comes up with the products of combustion from
 the fire, and the arsenic is deposited upon the malt
 as it goes through, and it will naturally, in proportion
 to the weight of the substance, be deposited in larger
 quantity on the rootlet than upon the grain which is
 large and comparatively heavy.

7042. (Mr. Cosmo Bonser.) I should like to ask a
 question with regard to the difficulties that this Com-

mission is in on the question of different samples
 having been analysed for arsenic, and of different
 chemists giving absolutely different results. We have
 had extremely variable replies to the same sample,
 varying from 1-5th to 1-50th, and, as a practical
 brewer, I was going to ask you whether you would
 think it possible that the difference in the sample being
 drawn from the top of the cask or the bottom of the
 cask might make some difference?—No, not in the case
 of the beer. I should say it would make no difference.

7043. I presume you use finings?—Yes, for most of
 our beer.

7044. What acid do you use for dissolving the isin-
 glass?—Sulphurous acid.

7045. Not sour beer?—No.

7046. Those finings would fall, I presume, to the
 bottom of the cask?—Yes.

7047. Would not they collect a certain amount of
 arsenic or any impurity?—They collect all mechanical
 impurities, of course, and I am not prepared to say that
 they might not collect arsenical impurity. I do not
 think so, because I should look for the arsenic in solu-
 tion. But I am not prepared to say it does not. On
 that subject of the differing results from different
 chemists may I point out that the determination of ex-
 ceedingly minute quantities of arsenic is a very delicate
 one. It is not one that can be reduced to terms of an
 ordinary balance; you cannot get it out and weigh it
 like you can lime or anything of that kind. And these
 very minute quantities are reported upon the basis of
 certain appearances in the Reinsch or Marsh tubes,
 and a good deal depends on the personal equation of
 the analyst. I look upon it as very desirable that there
 should be some kind of exposition of a standard method
 to be devised by a committee of the very best and most
 accomplished chemists connected with the higher
 chemistry and our trade—a standard method ap-
 plicable to beer and the other substances used in our
 business by which the appreciable quantity of arsenic
 which shall be considered objectionable shall be found,
 and so the product or the beer condemned.

7048. You would be prepared to accept one of the
 Government Departments to name that standard?—I
 should have far more confidence in a recommendation
 made by the Government Department in conjunction
 with a committee of experts outside the Department.

7049. I expect no Government Department would after
 name a standard of that description without such a thorough in-
 vestigation.
 thorough scientific enquiry?—Then I would have per-
 fect confidence in it.

7050. What is in my mind is that you may set a
 standard to-day which may be absolutely and totally
 inapplicable ten years hence. To-day's knowledge may
 be varied by something which may happen, and con-
 sequently you will want some Government Department
 from time to time to readjust the standard if neces-
 sary?—Under these circumstances I would have every
 confidence in a recommendation made by the proper
 Government Department.

7051. (Dr. Whitelegge.) In issuing your circular to
 the members of the Country Brewers' Society on
 November 29th, did you suggest any particular test or
 standard?—No, that is not our business. I do not
 think the society is competent to make such a recom-
 mendation; we merely advised that they must not for
 their own safety use glucose and sugars without having
 them analysed.

7052. In your own case you have examined not only
 the beer, but all the ingredients, and only in one case,
 that of malt dust, you found arsenic?—That is so.

7053. Are we to understand that all the rest were
 absolutely free from arsenic?—Absolutely.

7054. No trace?—No trace.

7055. Were those results confirmed by the scientific
 advisers of whom you spoke?—No, I did not think it
 necessary to send my material to London or to incur
 any very great expense. I am a Fellow of the Institute
 of Chemistry myself, and my head brewer is at least as
 competent a chemist as I am—I should say much more
 so—and we considered ourselves quite capable of doing
 it at home.

7056. Had Dr. Moritz and Dr. Morris been advising
 the society before this recent arsenic question?—
 Generally for years. Dr. Moritz has been our adviser
 for a great many years; Dr. Morris only more recently,
 when he joined Dr. Moritz.

7057. In the case of the malt you buy, is that brushed

Mr. T. W.
Overbond.
 4 May 1901.

Standard
 method of
 analysis for
 arsenic in
 beer should
 be prescribed

still
 not known
 method of
 analysis for
 arsenic in
 beer should
 be prescribed

arsenic
 more than
 it.

Mr. T. W.
Loribond.

4 May 1901.

All malt at
his brewery
is brushed.

before delivery to you or after?—I should say in the case of what I buy in Newcastle it is brushed, because they have a perfectly appointed malting, and they are very smart people. What I buy in one or two places I think probably will not be brushed, but run over a screen, but I cannot say with certainty. It will depend on the enterprise and perfection with which the malster carries out his malting process.

7058. If it reaches you without being brushed, would it be brushed?—Yes; whatever is done to it beforehand.

No guarantee
as to fuel
demanded in
case of
bought malt.

7059. In bought malt, do you make any stipulation as to the fuel to be used?—No, I have never made a stipulation.

7060. Is it within your knowledge what fuel is used by the maltsters from whom you buy?—No. I simply confine myself to people in whom I have confidence, whose samples come up to the mark, and of whom I have some personal knowledge.

7061. The society are prepared to accept any precautions that seem necessary in order to prevent the risk of arsenic?—Yes. I feel sure that the society and the trade as a whole would cheerfully accept any reasonable precautions that did not involve the prohibition of the reasonable substitutes we have learned to use in the last 40 years.

Guarantee as
of purity
have only
doubtful
value.

7062. What sort of precautions are you thinking of—guarantees or analysis?—I do not think a guarantee is of much use. A general guarantee is practically a useless thing. A particular guarantee—that is, a guarantee with every delivery, is such a difficult and such a costly thing, that I think it would be not observed. It seems to me that the precautions that are required are to make the manufacturer of each material, whether it be beer or whether it be sugar, responsible for the quality of his substance.

7063. Make him legally responsible?—Certainly.

7064. Would you regard it as necessary for a brewer to analyse every malt he receives for arsenic in particular?—I certainly should now.

7065. Habitually and regularly?—Yes. After our experience of November, if a brewer does not take some steps to protect himself against arsenical contamination, accidental though it might be, he is not doing his duty to himself or customers.

7066. (Sir William Hart Dyke.) Would you have a penalty for not doing so, or would you place the penalty upon the result?—I think the state of the law itself is quite sufficient. People have been already fined very handsome sums for negligence in this respect. There is one very prominent instance in Northamptonshire and I sympathise very warmly with the result, where a board of directors and the brewer were heavily fined for not taking proper precautions.

Little
demand for
all-malt light
beer brewed
as in
Germany.

7067. (Sir William Church.) I should like you to inform the Commission why light beers like German, Bavarian beers cannot be brewed in this country from malt and hops alone?—I am not prepared to say they cannot be; as a matter of fact, there are two or three breweries in this country where they do more or less successfully produce such beers. Tennants, of Glasgow, produce a very good laager, as do the Tottenham Brewery in London, all from malt and hops, I believe. The reason why one does not produce the light German laager beer in this country is mainly that there is no great demand for it.

7068. In Germany the use of sugar in those light beers is forbidden?—Only in certain parts of Germany. There are parts of Germany where maize is largely used, and other parts where malt alone is used. In Bavaria, I believe, the law is very strict.

7069. It is not a matter of difference in the preparation of the malt?—Do you mean the difference in the production of the character of the beer?

7070. Yes?—There is a difference in the preparation of the malt and the mode of drying, but the essential difference is in the mode of mashing or preparing the worts. They are prepared there in a totally different way to ours; the worts are boiled, and we dare not do anything of that kind, and the result is they get a more dextrinous wort than we do, which means a less fermentable wort. The result is, although they use light gravities, they get comparatively more fulness in their beer on account of using these less fermentable materials.

7071. You would not agree with another witness who told the Commission that he thought that cylinder dried malt was used for these light beers, and would not be applicable for our general brewing purposes in England?—I do not know what he meant by the expression "cylinder dried malt." The essential difference between German and English malt, as far as drying is concerned, is that the English malt is dried by the direct products of combustion of the coke or anthracite coal being passed through the kilns and through the malt, and our experience is that if we substitute for that the German system, where the products of combustion are passed through metal tubes and the heated air from those metal tubes is used as a drying medium, we do not get the same character and flavour of malt as when we use the direct products of combustion. If by cylinder dried malt he meant a process by which hot air without the products of combustion were passed through cylinders, then I say the difference is a very material one, and the hot air process is not applicable to our English malts. It has been tried many times, and dropped.

7072. So that in your opinion roasting malt, if I might use such a term, without the direct contact of the fumes, would not produce a malt suitable for brewing beer to the English taste?—No, it would not. It has been tried many times and I do not know of any instance where it has been successfully maintained.

7073. (Chairman.) Is it a flavour conferred by the fumes that is wanted?—Yes. It is too complicated a thing to explain. We do not know why the differences arise but we do know that we get flavour from the malt that is dried direct from coke and from coal different from that which is dried by heated air. Empyreumatic products may account for it to some extent.

7074. Would the peat-reck flavour esteemed in Scotland for whisky do for beer?—No, I do not think so. I do not know of any instance, and I do not think there is an instance where brewers' malt has been dried by means of peat, and I should like to point out that the peat-reck would be far too powerful a flavour to make it applicable. Whisky is distilled and the peat-reck in the whisky is only that portion of it which comes over in the still.

7075. Is the flavour from oven coke the same as the flavour from anthracite?—Yes, practically; they are both fairly pure forms of carbon and as long as they are sulphur-free they are practically the same thing.

7076. (Sir William Church.) I think I understood you to say that the main object in brushing the malt was to get rid of impurities of all sorts, but especially of the spores of organisms. Are these organisms which have survived the heating kilns? Is not malt exposed to a temperature sufficiently high to kill organisms?—The drying process is not sufficiently high in temperature to destroy those organisms which are in the stage of suspended activity. If you will take the living organism, living under moist conditions, and put him into a kiln, I think you would inevitably kill him. But if you take an organism in a dried and inactive condition, I do not suppose the heat of the kiln would destroy it. Boiling water will not always destroy it.

7077. What is the heat that malt is exposed to?—160° to 210° F. We can only get as high as 210. Some tell me they get to 220, but I have my doubts. If we get much higher than 210 we impart too much colour to the malt. The malt begins to caramellise, and we cannot get the pale colour and the delicate flavour essential to fine beers.

7078. But the malt for porter is dried at a greater temperature?—Yes, that is done at a much higher temperature direct over fires at a very high temperature indeed.

7079. (Chairman.) For porter could not the process be carried on entirely in cylinders without exposing the malt at all to the fumes of the fire?—The proportion of black malt used makes it immaterial whether it is dried by the direct products of combustion or heated air; the actual process is that a malt, after being malted and grown on the floor, is dried on a kiln in the ordinary way to a fair condition of dryness, but to be converted to black malt it is taken shortly before it is required for use to revolving cylinders and there it is roasted like coffee over a glowing hot fire and almost touching.

Mr. T.
Loribond.

4 May 1901.

German
not exposed
to fumes,
flavour
unsuitable
English

Malting
temperatures

Black malt
roasted without
exposure
to fumes.

Mr. THOMAS EARP, called; and Examined.

Mr. Earp. 7080. (Chairman.) You are a partner in the firm of Messrs. Gilstrap and Earp, maltsters, in Newark-on-Trent?—I am.

7081. You have represented Newark-on-Trent in Parliament, I believe?—I did.

7082. You have been connected with malting for over 50 years?—Yes.

7083. During which time gas coke, oven coke, and coal have been used as fuel for drying and curing malt?—That is so.

7084. Have you found strong reason to prefer one or other of these three kinds of fuel?—Not reasons of sufficient strength to create a very great preference until the recent difficulties arose. We have also found that coal gave us less flavour which might be regarded as objectionable, less sulphur flavour, that is to say; but beyond that there has been no reason for giving it manifest preference.

7085. The coal must have been anthracite, not bituminous?—Yes.

7086. And you found anthracite preferable in respect of flavour than gas coke or oven coke?—Yes, that gave a much cleaner flavour.

7087. The difference being that there is more sulphur in the gas coke than in the oven coke?—In the gas coke especially.

7088. You tell us that you have never heard of any injury arising from the use of malt until the discovery of the effects of using glucose, that then enquiries were instituted which led to a suspicion that malt might contribute arsenic to beer, but that before this epidemic you had no suspicion malt could introduce arsenic?—That is so.

7089. Did your firm take any steps when as a result of this arsenical poisoning suspicion was directed to malt?—We instantly turned our attention to using coal exclusively. We took steps to shorten, to some extent, the period of exposure of the malt to the fumes; we endeavoured to exercise greater care in the treating of the malt on the kilns, so as to detach entirely every particle of the rootlet. We also tried the effect of brushing to some extent.

7090. Had you not done so much brushing before?—We had not; that was always left to the brewer. He was considered so far interested that our aim was to deliver the malt in a fair condition from a commercial point of view, and if brewers had special fancies for extra cleanliness we expected them to exercise their own care.

7091. You merely took the rootlets off by screening?—We merely took the rootlets off.

7092. Your firm submitted samples of malt and subsequently of cokes and coals for analysis?—We did.

7093. With what result?—I do not know whether the Commissioners would like me just to go through these particulars; I should be glad to do so.

7094. Perhaps you will kindly give us a statement of the results in respect to the analysis of malts?—I will just mention these figures and endeavour to do so in such a manner as to show how we have dealt with the difficulty. In the first place the impregnation of barley by various fuels in the process of sweating became a question with us.

7095. That is the first process?—Yes, the first process to which barley is subjected. We generally sweat it on the kiln, for 24 hours, and then after it has had time to cool, say a fortnight, we steep it, and we have always found since we established this enquiry that any impregnation which barley received, being absolutely free from any taint previously to sweating, was lost at about the sixth day of the growth of the barley on the floors. That no doubt is partly the result of the washing and sparging of the grain when it gets into steep. After the growth has gone at a temperature of from 50 to 60 and whilst the barley is yet green, say after the 4th or 5th day, we found no trace whatever of impregnation by arsenic.

7096. Did you find some impregnation of arsenic from the primary kilning?—Yes; but we consider that is lost in the process of flooring the malt.

7097. Washed out in the steeping do you mean?—Yes. Also lost in the agitation, turning and working of the barley, but, I think, most is washed off in the steeping.

4576.

7098. The next process in which there is exposure to fuel is the drying and kilning in the malting?—That is so.

7099. Did you find arsenic introduced by the kiln drying?—Yes. We find in the various coals we have used an average anthracite gave one-seventieth grain of arsenic per lb. of coal. The same coal being used for various malts, we have found an average of 1/350th of a grain of arsenic per lb. of the malt. That is by the Marsh test.

7100. (Sir William Church.) There would be a variation in that from 1/50th to 1/100th?—Yes, in the coal. Now I come to the oven coke, which we find to give at the rate of 1/30th of a grain per lb. of the coke. And we find that the arsenic in malt corresponds very closely with that given by coal; 1/300th as against 1/350th of a grain per lb. of malt. Hence we conclude that oven coke is not an entirely unsafe coke to use. Gas coke gave different results. In what we have tried of gas coke it has been tried in combination with coal and this combined fuel has given us 1/200th of a grain per lb. of arsenic in malt. A sample of the gas coke alone contained 1/14th grain per pound. We have practically discontinued the use of both cokes and we are relying on anthracite coal. These experiments have been made for direction in our own manufacture.

7101. (Chairman.) You did not find the oven coke sufficiently free from arsenic to allow you to use it with confidence?—Not so completely so as in the case of coal.

7102. And you have resolved now to use coal only?—Yes; we are using only coal.

7103. But oven coke you find compared favourably with gas coke?—Yes.

7104. Have you turned your attention to the question of extra cleaning and screening?—Yes.

7105. Are you entirely satisfied that the mischief already done is not to be entirely eradicated by any process of cleaning or screening?—When once done we do not find that by any means we can absolutely cleanse the grain.

7106. So that you look upon the use of any coal that contributes arsenic to the malt as involving a danger not to be overcome by any attention to the malt afterwards, such as brushing and screening?—My contention is that it is impossible to get it absolutely free, but one naturally concludes that as malt has been used from time immemorial, and apparently without danger or injury, it may be so used in the future if we only knew the exact point at which danger may come in. For that we are looking to the Commission to give us some information which may be valuable to us in endeavouring to avert any further catastrophe.

7107. (Sir William Church.) When you say from "time immemorial," can you tell me when charcoal ceased to be used?—A great deal of South country malt was dried with charcoal?—Charcoal has been used quite up to within 150 years ago. I spoke of malt as having been used from time immemorial, not coke.

7108. I thought you were using that as an argument of the fuel being free from arsenic?—The freedom of danger has existed since the discontinuance of the use of charcoal.

7109. That is not such a very great number of years ago, at all events in many maltings?—The great bulk of the malt has been produced by means of coal and coke drying for the last 200 years anyhow. No doubt charcoal is used, and I believe that peat has been used in old days.

7110. But 200 years ago would the bulk of the malt dried in the South of England or the Midlands be dried with coke or coal?—In the South of England coal I should think mainly. The nearer you come to the coal producing country the more coal is resorted to, and the earlier it was resorted to. But after the discovery of gas and the distribution of malting throughout the country, the various maltsters naturally relied on the nearest source of supply, which was a gas works. They were in ignorance of any danger arising from the use of it, and they simply used it—in fact, no danger was discovered and no injury apparently resulted.

7111. We have had a good deal of evidence that, comparatively speaking, few maltsters used gas coke because largely used of gas coke giving a nasty taste to the malt?—That is

Mr. T. Earp.

4 May 1901.

Oven coke renders malt less arsenical than gas coke

Arsenic cannot be altogether removed by brushing &c.

Use of charcoal in malting fuel.

Mr.
T. Earp.

4 May 1901.

the objection to it, but nevertheless it has been used and no doubt is largely used.

7112. Mixed I suppose with other coke or coal?—In some cases that would be so.

7113. (Chairman.) You have modified to some extent the period occupied in drying and curing malt?—We have been able to do that to some extent. During the last 15 or 20 years we have been generally using four days for the drying of malt, but in olden times, when I first knew the trade at all events, we never went beyond three days. The necessity for extending the time I think was brought about by the altered character of the beer preferred, and the use of sugar I think had something also to do with it. Malt has been made rather differently in order to work with sugar where it was thought desirable to use it. We used to make a more diastatic malt than we have made of late years, and in those days the three days' drying worked very well, but when less diastatic malt had to be produced we found a great advantage in slower drying in the first part of the process. In both cases we have had to use greater heat for curing and finishing.

7114. (Mr. Cosmo Bonsor.) Would the slower drying process give a larger increase of bulk?—Not necessarily. The quick drying in the old days would have the effect of promoting the growth of the acrospire in consequence of the malt being put on the kiln at a rather greater heat and forced a little, and the result was you got a greater bulk of lighter malt. Malt has been made heavier since the Malt Duty days.

7115. (Chairman.) Why made heavier?—I think it is the result of the better processes of brewing employed. More chemical knowledge being developed, the raw material has no doubt been used with greater care and with greater economy. To do that the extract producing properties of the malt have been increased.

Experiments
with coal
gas in place
of fuel.

7116. Have you tried some experiments in drying which might lead to some alteration in the construction of the drying kiln?—We have done that, but I am sorry to say we have lamentably failed to arrive at much advantage at present. We have tried also the effect of drying with gas, but that has been simply experimentally on a small scale.

7117. Producer gas or common gas?—Common gas. We have passed it through a burner recommended to us by Mr. Sugg; we get it as pure as possible and still we find a slight trace of arsenic, although it was but slight.

7118. As small as you have sometimes with anthracite?—Yes, quite as small as we have found with anthracite; I almost think rather smaller.

7119. So that you would consider gas a safer fuel than even anthracite coal in respect to arsenic?—I do not know that I could go as far as to say that, but as a matter of experiment we satisfied ourselves that we have a resource in the event of our being driven to it.

7120. Gas from different gas works made with different coals would be very different in quality?—That would be so. We are not without hope that the Mond gas which is now under examination very carefully, might possibly discover something very economical and effectual.

7121. You have not as yet had any opportunity of trying it?—No.

7122. It might be a great advantage if such gas could be supplied through a large district?—It might be of very great advantage, and we think it would. I am in correspondence with an electrician, a very old friend of mine, who is making some experiments with regard to the possibility of employing electric heat for drying, and if we had the Electric Power Companies sending heat direct from our coal pits into our kilns it would be a great triumph.

7123. Would the flavour from electric heat satisfy the customers of the brewers?—There is no reason why it should not I think.

7124. I am afraid if the flavour is wanted from the fumes of coal it would not be found there when electric heat is used?—We have brewing friends who contend that that flavour is not wanted. They are satisfied with a brewing material free from that.

Experi-
mental malt-
ing without
excess of
fumes to
grains.

7125. Have you yourself made any trials or otherwise had experience of drying the malt without allowing the fumes to have access to it at all?—Only experimentally. I tried it in a drum on one or two occasions long before the malting drums were in practical use.

but I was never satisfied with the flavour myself. One has been used to working up to a certain flavour. In fact, I have generally trusted my own palate to tell me what the flavour should be, and I think if malt had been as poisonous as some people suppose I should have been a dead man a long time ago.

7126. Have you ever tried a hot iron floor, non-perforated, to dry the malt on?—We have not tried that on a large scale, but we have put plates down just to try the experiment, and I am inclined to think that that may be a very advisable thing to try thoroughly.

7127. That would entirely eliminate arsenic from the malt so far as the drying in the kiln is concerned?—If malt is not allowed to have contact with the fumes from the coke or coal, that no doubt would be a very excellent plan.

7128. Would there be any great expense or difficulty in altering your present malt houses so as to dry without access to the fumes?—It would not be worth any consideration at all. We should simply substitute an iron tile not perforated for a perforated tile.

7129. Would that be easily done?—Easily done.

7130. You have not tried that on a large scale?—No.

7131. That would entirely get over the difficulty, and you could take whatever fuel is cheapest?—It would no doubt necessitate a modification in the system of turning. It would create the necessity for some structural alteration. We should be obliged to have machine turning in that case, because the plates would otherwise get so hot that they would char the malt.

7132. These technical matters are of great importance, but it might be easy to get over that by proper plates and air going between them?—I am quite satisfied myself there are no difficulties which might not be got over. It will largely depend on the disposition of the public to accept any decision which this Commission arrives at, and if the decision of the Commission permits the continued recourse to practices which have prevailed so long with great care against the accident of another Bostock difficulty, then intervention would not be necessitated. But if intervention and adaptation be necessitated, I am quite satisfied the difficulty can be overcome and a suitable article for brewing from can be obtained.

7133. Does the turning to which you refer on the drying plates have any effect whatever in keeping down the temperature of the plates? Suppose the turning is not practised, then certain grains of malt would remain longer in contact with the plates, and they might be burned, the hotter the surface, the place would become.

7134. Do you think the iron plate itself would become more charred?—The longer the malt remained undisturbed?—Yes.

7135. Is the turning done by a man walking about over it?—Yes.

7136. He walks amongst the fumes?—Yes.

7137. Can he work a great many hours doing that, or is he obliged to come away pretty quickly so as not to be injured by the fumes?—They generally open all the windows of the malt kiln when they are turning, and let in all the fresh air they can. It is a process which they carry out very rapidly. They do not often leave their work before they have done it. On a kiln of say 30 quarters, you would get two or three men; on a 60-quarter kiln perhaps four or five men. They very soon turn it over, and with the windows opened no injury appears to be sustained.

7138. I have walked over a kiln on one occasion in which anthracite coal was used, and I perceived a very decided curious acrid odour from the fuel, but that does not give an injurious flavour to the malt?—Not at all.

7139. Do you attribute the flavour of malt to any fumes benefit got from the fumes of the anthracite coal or necessity of the coke?—No; I think it is simply the effect of the heat and air.

7140. So that any difference between drying inside a cylinder and upon a flat floor must be due to an influence of the heat on each grain which is different according to the air it meets in one way or the other?—I think so.

7141. So that if air was driven through the cylinders it might probably have the same effect that it has at present on the ordinary malting floor with open windows?—I think it might.

M.
T. E.
4 May

7142. It seems a very important matter, and if it is comparatively simple to get rid of the admission of the fumes to the malt, the very great difficulty spoken of in respect to arsenic would be entirely done away with?—I think any direction which went so far as to be a general order on that subject would be a danger, but I think experiments should be encouraged. The circumstances of the time will bring about the experiments. We have waited until we have finished our work for the season, when there are several things we, as a firm, shall try, and no doubt our neighbours will do the same.

7143. I hope you and your fellow-workers in the same field will make good experiments. This Commission cannot determine what is the best way of drying malt, but I think after what we all know now, and nobody knew a year ago, great efforts should be made to improve the mode of drying and, if possible, to get malt with the proper flavour without any access from the fumes of the fire whatever. We are encouraged to hope that from what you have said you do not think it will be a great difficulty, and, not as one of the witnesses has said, entail enormous expenditure?—The suggestion made by yourself would not be an expensive matter; I mean to try iron plates not perforated. That could be done very simply. If it had not been for the question of the weight of carrying that out we should ourselves have tried it, but we thought it would not do to load the kiln with any additional weight. It might bring damage to the men.

7144. Thin iron, $\frac{1}{4}$ th or 1-16th of an inch, would not add much to the weight?—I do not think sheet iron is what we shall want. I think we shall want cast metal plates; I think they would do the work better.

7145. I might suggest an experiment on the floors after suitable modification, and if you find you can get the malt properly dried and a proper flavour in that way, the process might be extended so as to suit even the fumes of bituminous coal?—Quite so.

7146. For twenty years past you have had your own laboratory, and employed a chemist in your business?—That is so.

7147. In face of the importance of the crisis through which we have been passing, you have resorted more especially to professional chemists in London and in Manchester for tests?—Yes.

7148. And for advice independently of the work done on your premises?—Yes. That has led to the formation of our determination to stick to coal until something better, at all events, was found out. It has not carried us much beyond that.

7149. You feel public spirited enough to say that you and your brother maltsters may be relied upon to co-operate in efforts to secure any advantages arising from ascertained possibilities of improvement?—That is the feeling I believe of the whole of the trade.

7150. (Sir William Hart Dyke.) With regard to this question of the non-perforated floor, I suppose it has not been really tried on a large scale, or sufficiently tried by maltsters for you to be able to form a very decided opinion?—No. I will tell you what has happened in a particular case. We had a little old kiln at one time with a quaint old-fashioned cast-iron tile, with slits instead of round perforations, and in process of time when it came into our possession we found that it had been somewhat neglected, and the little slits were all filled up with the broken corn and so on. I saw the heap of malt that was made in the kiln, and I was astonished at the excellence of it. It was made from very nice barley. Undoubtedly it had been practically like an iron floor, because the interstices had been closed up by neglect. Some old maltster had worked it for a time, and the turning of the grain was perpetually cutting certain corns, and the farina in a soft state had worked into the interstices.

7151. (Mr. Cosmo Bonsor.) No draught went through it?—Very little, indeed; and very decent malt was made.

7152. (Chairman.) That malt that you say was so good was made without any access to the fumes?—Yes, by accident, and it convinced me there was a possibility of making good malt in that way.

7153. You are sure the fumes had no access to that malt?—I would not say they had literally no access, but I mean to say there would be hardly any.

7154. And the malt was certainly good?—Yes, it was
4576.

good. We have of course been going quite in the opposite direction lately, in that we have been getting very expensive floors, German wire floors. I have no doubt Mr. Bonsor knows all about them, and their cost. They consist of wide of triangular shape, and the upper side of the triangle is the floor, and there is an admission of the air very freely from below where the angle exists. The floors are very open, indeed. When you are underneath them and the malt is off, the light is hardly impeded; they are so very open. We have been working in that direction entirely under the belief that it was a very great advantage; if we had suspected arsenic would show itself we might have gone less in that direction.

7155. (Mr. Cosmo Bonsor.) You have always considered that draught is necessary?—Very much draught.

7156. (Sir William Hart Dyke.) From below?—Yes.

7157. It is the same with hop drying?—Everything has been made conducive to that in all our schemes.

7158. The plan just suggested would be a direct reversal?—Direct reversal.

7159. You have not really had a proof of what the effect on the malting would be beyond this one instance you know of where it was a partial stopping?—No.

7160. It was not complete?—No.

7161. You are aware the heat would get through in a different way through these little cracks that were stopped up than through sheet iron a quarter of an inch thick; the process would be almost revolutionising the system where you have had a thorough draught from below?—Yes. The hot air would be excluded.

7162. (Chairman.) The fact that good malt was made in the case of the happy accident to which you refer, might perhaps point to as good a result as that happy accident which led to the invention of roast pig?—Yes.

7163. On the other hand if air must go through the malt in a way it would not do if it was placed in an unperforated floor might not a double floor be used, one a continuous iron plate, or possible tile plate to take the heat of the fire, and a well perforated floor such as that you have described for the grain to lie upon, a few inches above it, so that there would be ample circulation of hot air from below through the grating and iron cloth on which the malt rests?—I think it would be quite well worth trying.

7164. The main thing is to try whether or not the chemicals in the fumes are wanted, or whether hot air properly circulated through the malt on a flat perforated floor would suffice without the chemicals of the fumes?—Quite so.

7165. It would be a very different thing from turning it in cylinders, which I understand is the only process hitherto employed for drying the malts without access to the fumes?—That is so; I know of none other.

7166. I believe I have been told that some of the fine German lager beers are made from malts which have been dried in cylinders, without access to the fumes. I do not know whether that is correct?—I believe that is correct, but it is a different class of beer. Its treatment and methods of fermentation are different altogether. I do not know whether the difference in the beer might not be accounted for in that way. It is not the beer, I think, that the Englishman would care for.

7167. (Sir William Hart Dyke.) It is quite evident, is it not, that experiments in all directions will now be made, apart altogether from what this Commission may precisely seek to have adopted; you and others in your trade will be using all your experience in every direction to try and get security?—We have been doing it all our lives in one direction or another. Maltsters endeavouring to improve their methods of security.

7168. You have been also cleaning your malt more than you have done previously, and it is assisting your customers?—Yes, we have done a good deal of that.

7169. As regards the purity and the protection of the public, those who drink beer, you would wish the liability to rest on the seller of the finished product?—There is no getting away from that, I think. Responsibility for purity should rest with brewer.

7170. You think that would be just and right?—Yes.

7171. You state here you considered you have reached a position in your manufacture which gives practical purity. With regard to that I suppose the security you consider to be behind you in that regard is really the fuel?—Yes. The employment of coal and the shortening of time. The three points are the adoption of coal, the slight shortening of the time of exposure, Ways in which malt is being reduced.

Mr.
T. Earp.
4 May 1901

Recently constructed malt floors very pervious.

Mr.
T. Kipp.
4 May 1901.
Importance
of malting
with anthra-
cite.

and the extra treating and screening keeping it clear of rootlets.

7172. You wish us to infer, do you not, that the real protection is good fuel, anthracite coal, because I think you have said in your evidence that it is impossible, take what care you may, and use what you may, to get all the arsenic out of malt when it has been conveyed there by fumes?—That is so.

7173. Therefore your real security is the fuel?—That is our sheet anchor now.

7174. And that is the use of anthracite coal?—Yes.

7175. (Mr. Cosmo Benson.) You used to dry on tiles, I think?—We did largely.

7176. (Chairman.) Perforated tiles?—Yes, earthenware tiles.

7177. (Mr. Cosmo Benson.) You discontinued the earthenware tiles because the holes got blocked up and you did not get sufficient draught?—They were much more liable to block.

7178. And you did not get sufficient draught through your places?—That is so.

7179. You took the wire flooring from your kilns practically after the Ware system, and the idea of the Ware system of kiln was to get as near as possible to a chimney as could be devised?—That is so.

7180. And that is practically the kind of kiln you have at the present moment?—Yes.

7181. Consequently it would be more or less of a retrograde movement to go back to anything in the form of a closed chamber?—It would be that, undoubtedly, so far as pre-conceived ideas are concerned. The only question is as to whether the new conditions and new requirements do not necessitate even what appears to be a retrograde movement sometimes. We may have departed from the right whilst thinking we were going away from the wrong.

7182. I presume that the experiments you have had on your malt show that it is practically free from arsenic at the present moment?—Practically, at present, free. We have no complaint from day to day, and, moreover, there is a cessation of all the excitements and the deaths. If we had never had the Bostock misfortune I should not have the honour of appearing before the Commission at this moment.

Official
standard of
purity of
malt is
needed.

7183. You would be prepared, I presume, to give to the brewer a guarantee of practical purity?—I do not say absolute purity?—Yes, practical purity—we are giving that.

7184. And you would be prepared to accept a standard of what is practical purity from one of the large Government Departments?—That is what we very much require. Nothing would please the trade generally more than to know what is expected of them, and what they may safely do, and I am sure they will do it.

7185. (Dr. Whitelegge.) Can you tell us the exact terms of the certificate which you give of practical purity from arsenic?—I am afraid I could not remember. We have not adopted one particular formula. We

have varied it according to the exigencies of the case and the exactions of our friends. Some are content with simply a very thin guarantee; others are very exacting, and want something very safe. We have generally gone on these lines, and we have found it pretty generally accepted too, that we will guarantee that no malt shall leave our premises without our being satisfied that it is practically free from impurity.

7186. In speaking of arsenic derived from coal, you gave us figures showing arsenic in malt to the extent of 1-400th, 1-300th, and 1-350th?—Yes.

7187. Would you be prepared to give the certificate of the sort you named in connection with the samples containing, say, 1-300th?—Specifying?

7188. No; according to the examples you gave us, malt, in the preparation of which coal has been used, may contain 1-400th or 1-300th. Would you regard that as a sample of malt to which a certificate in the general terms you described would be appropriate?—Yes.

7189. You would not expect the brewer to understand your certificate to mean that there was not a trace of arsenic, even 1-300th of a grain to the lb.?—No, we should not expect that. There are so many uncertainties and there are so many difficulties even with regard to the purity of the particular material used in making the tests.

7190. (Sir William Church.) Who do you think ought to do the final brushing of the malt, the maltster or the brewer?—I hope that nothing will occur to place an obligation to do the final brushing in the malt kiln. We should want to extend our kilns very much, and we should have no end of difficulty if we had all that to do. Of course it is not an impossibility, and I fancy in some breweries there are machines which allow a certain amount of brushing to be done before the malt reaches the rollers. I think that is a safeguard to some extent, and that might be assisted by a little fan.

Brewer
should
malt, no
maltster

7191. I was not so much enquiring as to the way in which it should be done. We have had evidence before us—one brewer, if not more, said that he thought the final brushing was best done in the brewery, because they can judge better a sample of malt before it has had this final brushing than after it has. He went so far as to say that an inferior quality of malt well brushed might pass as a good sample?—I think the brewer may be trusted to find out that.

7192. You told us you had in your employment a chemist for 20 years. I presume that his business was really only to examine your materials for trade purposes. He did not examine them for accidental contaminations?—No, but in order to ascertain whether we were complying with the requirements of the chemistry of brewing.

7193. Whether your proportion of maltose was right or that sort of thing?—Quite so.

7194. You never examined for arsenic?—No.

7195. Or any other accidental impurity?—No, we never suspected anything deleterious.

Mr. LAWRENCE BRIANT, called; and Examined.

Mr.
L. Briant.

7196. (Chairman.) You are a brewers' analyst, and have been in practice as such for 22 years?—Yes.

7197. I believe you are also the author of a book on brewing?—Yes. I am the author of a Laboratory Text Book for Brewers, which has gone through two editions, and I think I may claim to have an intimate knowledge of brewing operations and of the materials which are used therein. Since the end of November last I have examined a large number of beers and the materials with which they are brewed for the presence of arsenic, the number so examined being considerably over 2,500.

7198. I believe you have been requested by the Chemical Manufacturing Section of the Brewery Traders' Association to make enquiries on their behalf into the presence of arsenic in their manufactures, and the precautions which are taken to prevent such contaminations?—Yes, and with that object I have visited the works of the firms connected with that Association, which, whilst not including absolutely the whole of the firms which supply brewers with preservatives, etc., is certainly representative. I have made enquiries into the methods of working, and though it is obvious that in some cases special processes are employed, the de-

tails of which the manufacturer does not care to disclose, yet every facility has been afforded to me for obtaining information upon all points bearing upon the questions at issue. I have also collected from my brewery clients a number of samples of preservatives, caramels, etc., which have been supplied to them prior to the end of November last, that is to say, before the possibility of arsenical poisoning by beer was realised. So that I have examined samples both from manufacturers and supplied direct to me through brewers. These latter samples represent, therefore, the normal output of such firms prior to any alterations which might have been made in their manufacture after the discovery that arsenic had been found in beer.

7199. What method of analysis did you adopt?—I have used the Marsh method, except at the commencement, when I used the Reinsch test. The Reinsch test, of course, is not as satisfactory in some respects as the Marsh, but it had the great advantage of being very simple and quickly performed, and at the commencement of the difficulty which occurred it was necessary to get through a large number of samples. Lately I have used the Marsh test almost exclusively. I have tried the Gutzeit test, and I have rejected it.

Mr.
L. Br

By the Marsh test I am able to detect with ease the presence of 01 milligramme of arsenious oxide.

7200. How much material?—In 50 grammes of material. When I speak of substances as free from arsenic I mean that no arsenic can be found by a test of the delicacy above named when operating upon about 50 grammes of the substance under examination. The substances into which I have made a special enquiry are:—(1) Hardening materials; (2) antiseptics; (3) finings; (4) caramelised preparations; (5) yeast foods. In considering the liability of the substances which I have specially examined to introduce contamination, it is necessary to recognise the relatively small quantities which are employed by brewers. Taking the maximum amount of ingredients used in ordinary brewing operations, it will be found that with most substances used the actual quantity introduced into a gallon of beer is extremely small, so that a very gross contamination of this material would be necessary to introduce any perceptible amount of arsenic into the beer.

7201. Can you give the Commission a list of the firms or companies invited to give samples of the various materials?—I can give you a list of the names. This particular manufacturing Section includes the majority of the chemical manufacturers who supply brewers with material. It does not absolutely include the whole, but for the purpose of preparing evidence for this Commission, I thought it best to secure samples from the whole of the manufacturers who supply brewers with chemicals.

7202. What are the hardening materials?—Hardening materials are used by brewers for the purpose of raising the mineral matter in their waters to certain standards. The amounts of hardening material added necessarily vary according to the character of the beer which is required, but the maximum amounts generally added are as follows:—

Sulphate of lime - - -	50 grains per gallon.
Sulphate of magnesia - - -	10 " " "
Chloride of calcium - - -	20 " " "
Chloride of sodium - - -	50 " " "
Potassium sulphate or chloride -	15 " " "
Kainit - - -	50 " " "

7203. What is kainit?—Kainit is a natural deposit supposed to have been derived from evaporation of an inland sea. It is obtained from mines in Stettfurt, in Germany. It is mined out of the ground. The coarser varieties of kainit are, I believed, used as a manure. The finer varieties are used for hardening purposes. In some cases they are purified first of all. In other cases they are used without any treatment. Kainit consists essentially of a mixture of potassium sulphate, magnesium sulphate, and sodium chloride.

7204. Are the quantities of the different substances given in this table the quantities of the substances habitually added?—Not the whole of them.

7205. One or the other?—One or the other.

7206. Something of all?—No, not exactly. It entirely depends upon the character of the beer. In some cases chloride of sodium alone would be used. In other cases kainit alone would be used. In other cases a mixture of sulphate of lime and sulphate of magnesia would be used, but in any case the total amount of hardening materials added would seldom exceed 50 grains per gallon.

7207. Is something of hardening material essential?—For certain classes of beer with certain waters.

7208. Is that to please the taste of the consumers?—Yes.

7209. Not to make the beer keep?—It does render the stability of the beer higher, undoubtedly. In Burton, the district from whence the most celebrated pale ales of this country come, the water naturally contains a large quantity of sulphate of lime, and a moderate quantity of magnesia salts. If we wish to brew a pale ale of Burton character in a district other than Burton we add to our water supply the salts which are deficient in that supply; that is to say, we add sulphate of lime and sulphate of magnesia.

7210. And does that make a perceptible difference in the flavour of the beer?—It makes a very great difference in the flavour of the beer. In fact, we cannot pro-

duce a high-class bitter beer without the presence of sulphate of lime.

7211. We shall be very much obliged if you will hand in a list of the persons or firms from whom you received samples, and whose works you visited?—Yes, I will do so.* May I explain that the firms whose works I have visited do not by any means exhaust the firms from whom I have received samples. A number of samples have been received direct from my brewery clients; in fact immediately the possibility of the access of arsenic to beer was realised, practically the whole of my clients in the United Kingdom sent to me the whole of their materials, necessarily including their hardening materials and preservatives; so that I have, in that indirect method, analysed practically the whole of the preservatives, hardening materials, yeast, foods, and other materials which have been produced by English manufacturers.

7212. Sulphate of lime is added in the form of Calcium gypsum?—As a rule in the form of gypsum. In a few cases, in place of gypsum, an article called precipitated sulphate of lime is employed. It is employed in place of gypsum because gypsum is rather slowly soluble. When precipitated sulphate of lime is employed it dissolves almost immediately, hence it is sometimes used. Precipitated sulphate of lime is made by suspending chalk, or whiting, which is a purified form of chalk, in water, and adding to it sulphuric acid. The sulphuric acid decomposes the chalk and produces sulphate of lime, which deposits from the liquid. That sulphate of lime is washed, and is then supplied to the brewer, usually in the form of a paste, in which form it is very easily soluble, and is in many ways preferable to ordinary gypsum.

7213. Is it dissolved in the beer?—It is dissolved in the water with which the beer is brewed, and is carried forward into the beer.

7214. Then it is sparingly soluble?—Gypsum itself dissolves rather slowly, being soluble to the extent of a little over 100 grains per gallon.

7215. (Mr. Cosmo Benson.) When gypsum is put into water the water takes up exactly the amount of gypsum that it can contain?—Undoubtedly, no more.

7216. Gypsum is a Derby spar, which practically makes the same water as the Trent, the waters used in Burton beers?—Yes.

7217. The spring rises in gypsum?—Yes. The gypsum which is added is mined out of the same districts from which the Burton waters are obtained, and instead of drawing our water from Burton we bring the gypsum to the water.

7218. (Chairman.) Is there a saturated solution of gypsum? Do you put in as much gypsum as the water will dissolve?—Not quite.

7219. It is not saturated?—It is not saturated. There are objections to complete saturation. We find that if we saturate our water with sulphate of lime the beers do not clarify as quickly as they otherwise would, or as quickly as we desire for the present class of trade.

7220. Do you also use common salt?—Yes, it is used Salt, usually in the brewing of mild beers, not in bitter beers. The ordinary bar salt of commerce is that form of salt which is usually employed, just the same salt as we use on our tables.

7221. Other sulphates or chlorides are also used?—They are not frequently used; they are sometimes used.

7222. Is that for obtaining various flavours in beer?—For hardening.

7223. And also for flavouring?—Certainly. In certain districts certain particular flavours are desired. In certain districts waters containing large quantities of chlorides produce the desired flavour of beer. In other districts waters containing large quantities of sulphates produce the required flavour of beer. The brewer seeks to treat his water so as to produce a beer suitable to the particular district which he is supplying.

7224. Did you discover any arsenic in any of these substances?—I have discovered arsenic in a few of

* Note by Witness.—This is the list referred to:—Boake, Roberts, A., and Co., Ltd.; Burgoyne, Burbridge, and Co.; Cafferata and Co.; Clowes, Walker, Limited; Collett, J. M., and Co.; Gillman and Spencer, Limited; Hallams, Limited; Kendall, F., and Son; Malto-Peptide Co.; Prentice Brothers; Vanguard Manufacturing Co.; Von Heyden's Chemical Co.

Mr.
L. Briant.
4 May 1901.

Mr.
L. Briant.
4 May 1901.

Kainit may be arsenical, but should not introduce material quantity of arsenic into bear.

the materials, but the amount has been extremely small. The largest amount of arsenic which I have found in any material has been in kainit. In that material I have found, approximately, .02 milligramme in 50 grammes of the material, that is to say, .0028 grain in a pound of kainit.

7225. That is grains of arsenious oxide, not so much arsenium?—Not the metal, but the oxide. Assuming that 50 grains of this material were present in a gallon of beer—and that is a very large amount, the maximum which would be present—then even if a material of the maximum impurity which I have examined were used, only '00002 grain of arsenic per gallon could be introduced into the beer. The amount introduced is so small that it is practically negligible.

Ensom salts.

7226. The other materials mentioned under this heading contain no arsenic, or less than the above-named amount?—Yes, I have found a small amount of arsenic in some samples of commercial Epsom salts. The amount of Epsom salts which a brewer uses is very small. I have never found more than .01 milligramme of arsenic in Epsom salts, and, calculated out, based on the amount which an ordinary brewer uses, it comes to the fifth place of decimals; and when we remember that Epsom salts are used in very large quantities, without particular danger to ourselves, medicinally, one cannot think that the use of three or four grains per gallon of Epsom salts can be of much matter when one is in the habit of taking $\frac{1}{4}$ ounce of Epsom salts.

7227. (Mr. Cosmo Benson.) Do you recommend Epsom salts to be used in beer?—I do not, personally.

7223. (Chairman.) Is it according to the taste of the consumers in certain districts that Epsom salts is added to the beer?—It is derived from this, that a certain small amount of magnesium salts is undoubtedly present in some of the Burton waters, and brewers who are endeavouring to produce beers of Burton type perhaps too slavishly copy all the ingredients which are present in the Burton water.

Kaimt.

7229. If kainit is a natural earth and occasionally contains arsenic, may not particular masses of kainit be notably arsenical?—That is possible. I can only say I have examined, I believe, about 28 samples of kainit drawn from breweries all over the kingdom, and I have not found any arsenic in 25 out of the 28. But in three I have found arsenic. The largest amount of arsenic which I have found in any of those is, as I have stated, .02 milligramme, in 50 grammes, equal to .0028 grain per lb., an amount which, I think, is quite negligible.

7230. Is kainit used by a great many brewers?—A considerable number of brewers are using kainit.

7231. Do the brewers get it chiefly direct from Germany, or do they buy it from sellers of chemical materials in England?—Most usually from sellers of chemical materials.

Preserva-
tives used
in beer.

7232. What do you say as to antiseptics?—The greater proportion of preservatives used in beer consist of preparations of sulphites, the active agent being, of course, the sulphurous acid (sulphur dioxide) contained in the sulphite. In addition to sulphites, small quantities of salicylic acid are sometimes employed. The quantities in which preservatives are added are quite small, and may, I think, be fairly taken to be as follows: calcium, sodium, or potassium sulphite are used at the rate, usually, of one ounce per barrel of beer. This is equivalent to about 12 grains per gallon. In a few and quite exceptional cases, as much as $1\frac{1}{2}$ ounces per barrel may be used. Of liquid sulphites bisulphite of lime is that most generally used, and is the oldest preservative. It was used before any of the solid sulphites were introduced. The amount of that employed varies very considerably indeed, but generally lies between 6 and 10 fluid ounces per barrel; this is equivalent to about the same actual addition as of solid sulphites. Other special forms of liquid sulphites are supplied to brewers, and of those from 2 to 4 ounces per barrel are added, which are really equivalent to the same amount that I have above named of solid sulphites. Salicylic acid is used to the extent of $\frac{1}{4}$ or $\frac{1}{2}$, or, in exceptional cases, $\frac{3}{4}$ of an ounce per barrel, usually half an ounce per barrel, that is, to the extent of 6 grains per gallon. So that it is quite clear, in view of the very small quantities of these materials which are added to beer as preservatives, the very grossest contamination must have taken place to introduce any appreciable amount of

arsenic into beer. All these preservatives, so far as I have been able to ascertain, have been made with every reasonable care, and from commercially pure chemicals.

7233. I believe you have some information to give us with regard to sulphuric acid in this connection!—Sulphites, the basis of practically the whole of the preservatives supplied to brewers, are produced, of course, by the aid of sulphurous acid, and sulphurous acid is made by one of three methods. First, by the burning of sulphur; second, by heating sulphuric acid with sulphur; and third, by heating coke or charcoal with sulphuric acid. All of the makers of sulphites in England use one of these three methods. In every case of the factories which I have visited, the resulting gases are passed through a washer or scrubber before they are led into the saturation vessel, the vessel in which the sulphite is prepared. I found from direct experiments, a number of which I have made in my laboratory, and on a larger scale in the works, that if arsenic were present in the original acid it is entirely separated when the gases pass through the washer. In fact, the arsenic, if present, is held back in the washing vessel. Every manufacturer, so far as I have been able to ascertain, uses a washer for his gases, and therefore every manufacturer practically secures himself against any arsenic being carried forward into his products. The arsenic which is present in any preservatives, if it is present, is therefore not derived from the sulphurous acid. As a matter of fact, the sulphuric acid which is used in making sulphurous acid is, so far as I can ascertain, and has been, of very good quality indeed. In most cases it has been pure to the fourth place of decimals. I found on examining the books of some manufacturers whose works I have visited, that they have consistently, not lately, but for two or three years past, made examinations of the acid which they have employed, that they have tested for arsenic in the acid, and that they have only used acid which has been reasonably—I will not say absolutely—free from arsenic. The largest amount of arsenic which I have found in any of the sulphites has been .02 milligramme per 50 grammes, that is equivalent to .0028 grain per lb. As only about 12 grains of such a preparation is used in a gallon of beer, the actual amount of arsenic introduced would not exceed, in the worst sample which I have examined, .000004 grain per gallon; in fact, $\frac{1}{250000}$ grain, which is, of course, quite negligible.

7234. That we may consider as quite negligible?—I think so.

7235. In the case of a beer likely to go sour, might not a much larger quantity of bisulphite or other preservative be added?—It is unlikely. The amounts which I have given you are the maximum. A very large number of brewers do not use as large an amount as I have stated, that is to say, 1oz. per barrel of solid, and 6 to 10oz. of liquid sulphite. It is most unlikely that in any considerable number of cases larger quantities of sulphite than that given would be used. As a matter of fact, if larger quantities were used they would communicate a flavour to the beer, and would render it objectionable. The public taste would not permit larger quantities to be employed.

7236. (Sir William Church.) Is boracic acid ever used as a preservative?—I have made enquiries as to that from practically every manufacturer in England, and they all deny that boracic acid has ever been sold by them as a preservative for beer.

Boracic acid
not added
to beer.

7237. (Mr. Cosmo Bonsor.) Salicylic acid is very little used?—Very little. Salicylic acid seldom

Salicylic acid seldom

7238. It is used more for cleansing vessels and casks than for beer?—It may be used for that purpose. The amount of salicylic acid used is very small. The main preservative relied upon by brewers is some form of sulphite.

7239. I take it that in mentioning salicylic acid you mention it because it has been supplied to brewers, but it does not necessarily mean that it has gone into the beer?—No, but it is sometimes added direct to beer.

7240. It is more used for cleansing purposes, for getting rid of bad yeast that has impregnated wood in any form than for any other purpose?—Yes, it is a most powerful disinfectant, and for that purpose is most useful in destroying infection which may have occurred in wooden vessels. It is supplied to brewers, though it is not the main preservative upon which brewers rely.

7241. The principal preservative is bisulphite of lime!
—Yes.

Mr.
Briant.
ay, 1901.

7242. (Sir William Church.) With regard to salicylic acid being used for disinfecting and cleansing purposes, what has led brewers to use it for that purpose? It is not so powerful a germicide as many other things which are known?—No, not so powerful, for instance, as mercury, but we should be afraid to use a mercury salt in the interior of a fermenting vessel which was subsequently to be filled with beer.

7243. That is the very reason I asked you the question. It is used as being a germicide, and as one that is not poisonous?—Certainly.

7244. Except in very large doses?—Yes, that is the point. We wish to disinfect our vessels, which are subsequently to be filled with beer, and although we may wash the preservatives off we could not ensure that every trace of preservative was removed; therefore, though we all admit that mercury is one of the most powerful germicides, its use would be inadmissible and inappropriate for cleansing vessels which are to be subsequently filled with beer.

7245. (Chairman.) Is carbolic acid used in any cleansing?—It is not used in any vessels which are to be filled with beer or wort. Carbolic acid may be used on the floors but not added to the beer. The smallest quantity would absolutely ruin the flavour of the beer.

7246. Besides preservatives, there are what are called finings. Have you anything to say about these?—Finings are made from isinglass, the swimming bladder of the sturgeon, and the commoner sorts are made from soles' skins. Some very few samples are made from gelatine. The finings are, as we technically term it, "cut," that is, semi-dissolved by treatment by means of an acid. The acid employed for cutting or dissolving finings in very many cases is sulphurous acid. In some cases tartaric acid is added, as well as sulphurous acid. Sulphurous acid, as I have previously mentioned, is practically arsenic free, and the use of sulphurous acid is therefore not open to any objection. Tartaric acid is used in the preparation of some finings, and tartaric acid undoubtedly does, in some commercial samples, contain traces of arsenic. There is no doubt that it is an extremely difficult thing to get commercial tartaric acid which is absolutely arsenic free by the very rigid test to which we subject materials at the present time. For that reason personally I think it would be wise to reject the use of tartaric acid entirely from the preparation of finings. This is, however, only my own individual opinion. It is quite easy to make finings without their employment, in fact, in my opinion better finings can be made without the use of tartaric acid than with. Assuming that tartaric acid has been used, and assuming that it has been used in the proportion of 1 lb. of tartaric acid to every 7 lbs. of isinglass, together with 1 gallon of sulphurous acid of 5 per cent. strength, these materials would be sufficient to make a hoghead of finings. Before the hoghead of finings was used, it would be diluted with either water or beer, with an equal bulk, making two hogheads of finings, and then of that diluted material one pint to one quart would be added to each barrel of the beer. Taking the maximum amount of one quart and the quantity of tartaric acid used as that which I have named, the amount of tartaric acid introduced would not be more than 15 grains per gallon of finings, whilst the amount of sulphurous acid would be approximately half that. I have examined a considerable number of samples of finings for arsenic, and I have found a minute trace of arsenic in two of them. The worst sample that I examined contained arsenic to the amount of '016 milligrammes per 100 c.c., equivalent, that is, to '011 grains per gallon. Assuming these finings, which are the very worst that I have come across, to have been used in the maximum amount mentioned, the amount of arsenic which could be introduced into a gallon of beer would be '00007 grains per gallon. It is quite clear that whilst a very minute amount of arsenic, quite a negligible amount, might be introduced by the use of tartaric acid, the amount which would be so introduced would be nothing compared with the amount which must be commonly taken in the ordinary baking powders of commerce, most of which are prepared with tartaric acid. The amount of tartaric acid present in those must be enormously greater than can be present in beer.

7247. What is the largest amount of arsenic that you have found in tartaric acid?—I have not examined a very large number of tartaric acids. I have examined the finished products in most cases. But I have a few samples of tartaric acid which I have examined. I have one sample of tartaric acid which contained approxi-

mately one-fiftieth of a grain of arsenic per lb. of tartaric acid.

7248. Is that the greatest amount?—I have one further sample which contained one-thirtieth of a grain of arsenic per lb. Those are the largest amounts. The amount of tartaric acid used by a brewer in the preparation of his finings is, of course, very small indeed.

7249. The arsenic so introduced would be negligible in beer?—Absolutely negligible. At least I gather that as regards when you come to 1/10,000th of a grain per gallon it is negligible.

7250. Why should you use tartaric acid? Is it not more expensive than sulphurous acid?—It is not a question of expense, it is a question of convenience, and of quickness in cutting. Tartaric acid is found to cut finings to make them ready for use more rapidly than sulphurous acid, and for that reason perhaps has been used. The most practical brewers are of opinion that very rapidly prepared finings are not always the best finings, and that a slower method of preparation will often give a really more efficient article, and a great number of brewers now from choice prefer the sulphurous acid-made finings.

7251. How is the tartaric acid applied?—It is dissolved in water, and applied to the isinglass?—The isinglass is first of all washed, and soaked in cold water until it swells up. We then add the tartaric acid, which may be previously dissolved, or, in some cases, has not been previously dissolved, and a certain amount of 5 per cent. solution of sulphurous acid, that is, if we are using tartaric acid and sulphurous acid. The isinglass is allowed to remain in this acid solution, and slowly cuts, as we term it, that is to say, becomes disintegrated. Whether it truly dissolves or not is a question which is much disputed. It forms a sort of jelly-like mass.

7252. But is it not a jelly-like mass when it is moistened with water?—No, it is not the same form at all. It swells up into a solid jelly mass, but on cutting with finings it breaks down into a liquid, through which very minute particles of gelatine or isinglass are suffused in a state of semi-solution. We believe it is not true solution.

7253. If you filtered that through an ordinary filter, or blotting paper, would the isinglass be kept back?—Yes.

7254. As it is, it remains suspended in the water?—Yes. When we add that to the beer, then the yeast and other matters suspended in the beer attach themselves to the finings, and agglomerate into one solid mass, and fall through the beer and fine the beer, rendering it quite clear.

7255. Is the beer poured off, or is the sediment removed from it?—It depends upon the class of trade done. For the London mild beer the finings are worked out of the top of the cask, out of the bung hole. The finings are added to the beer, and the gas in the beer buoys up the finings, and they work out of the bung hole. The consequence is, you get a cask of absolutely brilliant beer. In the provinces generally the finings are allowed to work downwards instead of upwards and remain deposited at the bottom of the cask.

7256. How is the beer cleared?—Is it drawn off with a syphon or just left?—In an ordinary cask the tap hole is an inch or so above the bottom of the cask, and in that way the finings and the deposit are not disturbed.

7257. So that the beer is left on the lees, as it were, and drawn off gently from the top from above?—Yes, except in the London trade, when the finings are worked out.

7258. (Mr. Cosmo Bonsor.) London finings are never made with tartaric acid?—No.

7259. They are made with sour beer?—Yes.

7260. In the case where the finings work through the top, the isinglass is cut with sour beer?—Almost invariably.

7261. (Sir William Church.) That is to say, with acetic acid. Why is acetic acid not used for finings?—Sour beer, of course, consists of a mixture of acetic and lactic acids. Brewers are of opinion that the most effective finings are those made with sour beer.

7262. (Mr. Cosmo Bonsor.) It is a quick process?—Yes.

7263. (Chairman.) Is not sour beer dangerous?—That is the reason why such finings are not so much used with stock beers as they are with beers which are consumed very quickly.

Mr.
L. Briant.
4 May 1901.

Outside
London
sediment
after fining
remains in
cask.

Mr.
L. Briant.
(4 May 1901.)

7264. The sour beer does not leave a bad flavour?—No, the amount introduced is so small.

7265. (Mr. Cosmo Bonsor.) In examining finings under a microscope they are practically all small particles?—Yes, in a very minute state of subdivision.

7266. The fining of beer with isinglass dissolved in acid is quite a different process to what fining wine by eggs is?—Quite a different process.

7267. (Chairman.) What do the finings do? Is it the gelatinous matter that causes the material that you wish to take out to stick to itself?—The finings, which are in a state of semi-solution, when they are added to the beer, are thrown out of solution and pass downwards or upwards through the beer, according to the method of fining, carrying with them any matters which are suspended in the beer, leaving the beer brilliant.

Manufacture
of caramel.

7268. What about caramel?—Most caramels are made from glucose. In many cases liquid glucose is used for this purpose, sometimes solid. American and sometimes German glucose is employed. Some caramels are made from cane sugar, not from glucose. All the manufacturers of caramel from whom I have made enquiries deny that inferior glucose is in any case used by them. They inform me that it is necessary for their purposes to use a thoroughly high quality glucose, and such glucose they always buy. The amount of caramel added in the case of black beers may, in exceptional cases, be as much as 8 per cent. or 10 per cent., but usually it does not exceed 6 per cent.

Proportion
of caramel
used in beer.

7269. Eight per cent. to the volume measure?—Of the amount of materials employed.

7270. So that there would be 8 or 10 volumes of caramel to 92 or 90 volumes of beer?—No, to 90 volumes of malt and other sugar. Ten per cent. is the expression of the equivalent in what we term a grist of materials used for producing the beer.

7271. The caramels are to be used in brewing?—Yes.

7272. And put in before the brewing is completed?—put in at the commencement of the brewing?—After the wort is drawn off from the malt into the copper. The amount of caramel used in some cases is as high as 8 or 10 per cent.

7273. Eight per cent. of the wort?—Eight per cent. of the materials used for producing the wort. Supposing you have a grist of 50 quarters of malt, 8 per cent. of 50 quarters would be equivalent to 4 quarters of caramel.

7274. Then there is a great mass of water over and above that—the materials are put into water?—The caramel is generally added to the copper, and is not added to the mash tun at all. After the malt is exhausted in the mash tun the amount of caramel which is deemed necessary is added to the copper.

7275. (Mr. Cosmo Bonsor.) Take a 50 quarter grist; 40 quarters of malt, 8 cwt. of sugar, 8 cwt. of caramel would make a 50 quarter brew?—That is so.

7275a. That, I take it, is the material with which the beer is commenced?—That is so.

7276. The malt is put into the mash tun, water is added to the malt; the product that comes from the mash tun is pumped into the copper, where the hops and the caramel and the sugar are added?—That is so.

7277. (Chairman.) I do not see the percentage yet. What does the 8 per cent. refer to?—It is 8 per cent. of the excise brewing.

7278. I am afraid I do not understand, and I would like to know what it means?—I will be very pleased to work out an exact example for you.*

7279. How is caramel prepared?—Caramel is prepared from glucose, sometimes from cane sugar, and is prepared by heating, by "caramelising," as we term it.

7280. It is prepared in the purification of sugar, when it is conducted at a certain temperature?—Cara-

mel is not a by-product of the purification of sugar. It is specially prepared.

7281. But does it not also occur in the preparation of sugar by some of the older processes?—There is no doubt that the exposure of sugar solution to a high temperature, as used to occur before vacuum pans were used, did produce a certain amount of colouring of the sugar.

7282. That was not done by design, but now you make caramel by design?—Yes.

7283. How is the caramel used?—The caramel used by brewers is either a thick viscid liquid, which will only just pour, which has a specific gravity of about 1.050, or in the solid form, more usually in the liquid form. The solid form is about one-fifth stronger than the liquid. The whole of the caramels that I have been able to obtain have been tested for arsenic, and I have found no arsenic in any caramel of English manufacture. I have found arsenic in two samples of German manufacture, in no case exceeding one-hundredth of a grain per lb.

Arsonic
found in
German
caramel

7284. My questions with regard to the percentage were absolutely necessary in order to understand how much arsenic one-hundredth of a grain per pound of caramel could introduce?—Just so. Assuming that in the production of a black beer caramel was used to the maximum extent, then not more than 4oz. of caramel could be used, and taking the very worst example of caramel which I have ever examined, the caramel could not introduce more than 1-400th grain of arsenic per gallon to the beer. But such a caramel as I have mentioned (the German-made caramel containing arsenic) would not be used by a brewer. Every brewer would reject it.

7285. Reject it now. But had caramels ever been tested before for arsenic?—I think not.

7286. Is there any knowledge of sulphuric acid having been used in the manufacture of caramel?—Sulphuric acids are not used in the manufacture of caramel. Caramel is made by heating glucose, or cane sugar, either by itself, or sometimes by the addition of ammonia salts, such as carbonate of ammonia or carbonate of potash—that is by the addition of alkali, but not of an acid, to sugar or to glucose.

7287. Going beyond beer, to which this Commission is not limited, it becomes a very important question to know whether caramel is liable to be contaminated with arsenic. The caramels that you have examined, which have been made for beer, are the same as the caramels that are used for general food?—I believe that many of the caramels which are supplied to brewers are also supplied to the public.

7288. They are largely used?—They are very largely used, of course, for colouring purposes.

7289. Is there any risk of what are called yeast foods becoming contaminated with arsenic?—There are two sorts of yeast foods used, yeast foods which consist practically of phosphates and yeast foods which consist of nitrogenous matters. The yeast foods which consist of phosphates do, in one or two cases, contain minute traces of arsenic. The amount is very small, but they do, undoubtedly, contain it. I believe that is derived from the phosphates themselves, for so far as I have been able to ascertain it is extremely difficult at the present time to get any phosphate of commerce which is absolutely free from traces of arsenic. Almost the whole of the phosphates of commerce I believe contain minute traces of arsenic. Therefore, yeast foods which are made with phosphates are liable to contain a very small trace of arsenic. But when one considers the amount of yeast food which is used it becomes apparent that the danger of poisoning is nil, because the amount of phosphatic yeast food which is employed is not more than 1lb. to thirty barrels of wort or beer. The yeast food is added during the fermentation. The yeast food does not consist entirely of phosphates, but of a mixture of phosphates and such substances as malt, pea or bean flour. In two samples of phosphatic food I have found traces of arsenic. The largest amount found has been .02 milligrammes, which is a very small amount; and in view of the very small quantity of such food which is added to the beer I think the amount is quite negligible.

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* Example.—A 20 quarter brew of black beer might consist of 15 quarters pale malt, 2 quarters of black malt, 1 quarter of amber or crystal malt, 2 quarters of sugar; total, 20 quarters. Now, 2 cwt. of caramel is approximately equal in colouring power to 1 quarter of black malt. If, therefore, one-half of the black malt were replaced by caramel, we should use 2 cwt. (= 1 quarter of black malt), and should speak of the proportion of caramel as 5 per cent. in the total grist.

7290. Are the words "yeast food" technical words in breweries?—The liquid or wort extracted from the malt in which yeast grows is sometimes deficient in certain of the constituents which the yeast requires for its nutriment. Being deficient we add to that wort a food.

Mr. 7291. A food for the yeast to draw upon?—Yes. Just
Briant. in the same way that we might add to the ground certain
ay 1901. manures for supplying the plants with their food, so
we sometimes add food for the yeast plant. Those foods
are either phosphatic or nitrogenous. In the case of
phosphate yeast foods, minute traces of arsenic have
been found, but so minute as to be practically negligible,
remembering that only about 11b. of phosphatic yeast
food is added to thirty barrels, or 900 gallons, of beer.

7292. Since the epidemic, brewers have demanded
the phosphatic yeast foods to be free from arsenic?—
Absolutely arsenic free. There are also nitrogenous
yeast foods. These are made in some cases from malt
rootlets, in others from some nitrogenous material, the
source of which I do not know. The nitrogenous foods
made from malt rootlets are made entirely from malt
rootlets which have been dried with anthracite coal, and
have always been so made, because it was found that the
flavour was injured if rootlets were used from malt
which have been dried with gas coke. The malt culms
which have been used have been always practically free
from arsenic, and inasmuch as the amount of yeast food
added is only about 11b. to twenty or thirty barrels,
sometimes considerably less, it is quite clear that the
amount of arsenic introduced is perfectly negligible.

7293. (Dr. Whitelegge.) Is not a considerable quantity

of arsenic found sometimes in sodium phosphate?—
That is so.

7294. I have an example before me which was found
to contain .072 per cent., or five grains of arsenious oxide
per lb. That is a much larger quantity than you have
met with?—Much larger.

7295. So that on that basis a material increment of
arsenic might occur in the beer?—Undoubtedly. It is
very difficult to get phosphates which are absolutely
free from arsenic at present.

7296. (Chairman.) Is that because of sulphuric acid
having been used in the preparation of the phosphates?
—Yes, I believe so.

7297. In general, are the firms which you have visited
taking precautions as regards arsenic?—They are tak-
ing every precaution which they are able to take. In
every case they have chemists who test the products
which they make. The whole of the materials as they
come into the works are carefully tested before they are
accepted, and every precaution which can be taken is
now being taken.

7298. Are they asked to guarantee their products as
arsenic free?—Almost invariably.

7299. And do they do so?—They do so.

Mr.
L. Ribant.
4 May 1901.

Manufac-
turers of
brewers'
chemicals
now taking
precautions
to exclude
arsenic.

and
guarantee
their chemi-
cals to be
arsenic-free.

FIFTEENTH DAY.

WESTMINSTER PALACE HOTEL.

Friday, 10th May, 1901.

PRESENT:

Sir WILLIAM CHURCH (in the Chair).

Prof. THORPE.

Dr. WHITELEGGE.

Mr. COSMO BONSOR.

Dr. BUCHANAN, Secretary.

Mr. EDWARD WILLIAMSON, called; and Examined.

7300. (Chairman.) You are the Secretary of Bostock's
and Co., Ltd., I believe?—I was the Secretary of the
late Company.

7301. They are now in liquidation?—That is so.

7302. And you are desirous, I think, of putting in a
statement to the Commission?—Yes. In view of this
action which we have entered against Messrs. Nichol-
son; perhaps it would be better if I were allowed to
hand in a written statement. If questions were asked
they might lead in some way to a prejudice of the case
pending.

7303. This, I believe, is your written statement?—
Yes; and with your permission I will hand it in.

7304. Since it was printed, I think, your statement has
received some manuscript corrections?—Yes; that is,
slight alterations.

7305. And you are therefore content that this as it
now stands should go in to the Commission?—Yes.

7306. The Commission do not propose to in any way
cross-examine you upon your statement, but there are
a few questions bearing upon it which we wish to ask
you. We understand that there is a considerable amount
of glucose and invert sugar which is contaminated with
arsenic still in possession of the liquidators?—Yes;
that is so.

7307. Besides that which was left on your hands, I
understand that some is what has been returned to you
from the brewers whom you had supplied?—Yes; that
is so.

7308. Could you give the Commission any idea as to
how much there is?—At present I think we have about
700 tons.

4676.

7309. (Prof. Thorpe.) Do you refer to both glucose
and invert?—Yes.

7310. (Chairman.) Has any been disposed of since it
was found to be contaminated?—About 100 tons alto-
gether.

7311. In what way?—We have disposed of it for tex-
tile purposes to calico printers who use it, to tanners and
curriers, and we have sold it to various drysalters as
middlemen. We have, however, stated on the invoice
that it was contaminated with arsenic and unfit for food
and drink purposes. We thought at the time we might
sell it on those lines.

7312. (Professor Thorpe.) Have you sold both invert
and glucose?—No, glucose only.

7313. (Chairman.) With no other safeguard except
your statement that it was contaminated with arsenic?
—That is the only safeguard.

7314. The sale was made on behalf of the liquidators.
I suppose?—Yes, principally, the liquidators were not
appointed until the 1st of April, and that was on account
of the Official Receiver.

7315. Do you know whether the liquidators propose
to take steps to sell it in the same way or in any other
way?—That is their intention.

7316. Is there no way by which the public could be
more safeguarded from accident? We know some of
your sugar was used by children to make toffy, and
with bad results?—We were not aware of that.

7317. They took it from a brewer, and they might in
the same way take it from a leather-dresser's store?—If
you think it necessary, or can suggest any other method

Mr. E.
Williamson.
10 May 1901.

Safe of
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such.

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Mr. E.
Williamson.
10 May 1901.

of safeguarding the public, I have no doubt it will be done.

7318. It is not for the Commission to suggest; I ask you whether you would make any suggestion on the point?—I really do not know what other safeguard we could adopt; that is, if it is intended to be sold at all. Of course, it could be destroyed.

7319. 700 tons of poisonous substance I suggest to you is a very dangerous thing?—Yes, if there is any chance of it getting into a food product it would be dangerous.

7320. Is there any way in which it could be stained so that nobody should think of using it for food? Is there any means by which it could be made disagreeable to the taste?—If you did that you might render it useless for textile purposes; that is the only thing which occurs to me.

7321. (Prof. Thorpe.) It is quite conceivable to make it repulsive by the addition of small quantities of material which would not affect its use for commercial purposes as you suggest, but would entirely prohibit it from being used as food?—If that can be done, I have no doubt it will be done.

7322. (Chairman.) I do not think it is for the Commission to suggest that, but I think it is a part of the Commissioners' duty to suggest that this substance should not be parted with by Messrs. Bostock, or by the liquidators, except with such precautions as are necessary to guard against accident from its use?—Yes, that is a matter which I will put before the liquidators for their consideration before they dispose of any more.

No action by
M.O.H.
regarding
Bostock's
arsenical
sugars.

7323. (Dr. Whitelegge.) Has the Medical Officer of Health for Garston been consulted about this stock?—He has not.

7324. He has taken no action in the matter?—No.

7325. (Chairman.) I put this before you. I think before this substance is parted with the Commission

ought to be informed as to what steps it is proposed to take?—Very good, sir; I will see that you are informed.

Mr. J.
William
10 May

7326. I think you received a letter from the Commission, dated 19th Feb., in which the Commission stated that they would be obliged if you would inform them at an early date of any proposals which may be made for disposing of the sugars in question?—Yes, that is so.

7327. And you acknowledged the receipt of that letter, writing, for Messrs. Bostock, "We beg to acknowledge the receipt of your favour of yesterday's date, re our stock of contaminated sugars, which we will bear in mind"?—Yes.

Additional
precauti
promises

7328. Notwithstanding this, we have at no time received any information from you that any was disposed of?—That appears to have been overlooked. It has been in many people's hands since that date. We went into voluntary liquidation, then into the Official Receiver's hands, and now the firm has gone into compulsory liquidation, and in that way the communication appears to have been overlooked.

7329. It is a very important thing to be overlooked; our letter was addressed to the liquidators?—Yes.

7330. Whether they are compulsory liquidators or not, it was addressed to the liquidators?—I believe at that time it was in the hands of the Official Receiver, and that letter was handed to him.

7331. Perhaps you will take all steps necessary to ensure that there are no other omissions?—I will. I will undertake to.

7332. And you will keep the Commission informed of the destination of any of your invert sugars or glucoses if disposed of, and what precautions have been taken, or what precautions you intend to take, and what is the destination of any which is disposed of?—I will see that this is done.

Mr. E. G. FRANCIS, called; and Examined.

Mr. E. G.
Francis.

7333. (Chairman.) I believe you are manager of the Manbré Saccharine Company?—Yes, and also director.

7334. You have occupied the position of manager for 23 years, I think?—That is so.

7335. During the first two years of that period the works were in Booth Street, Spitalfields, and the rest of the time at Fulham Palace Road, Hammersmith?—Yes.

7336. During the whole of that time the sulphuric acid used in the works has been supplied by Messrs. James Gibbs and Company, Limited, of Victoria Docks, with the exception of a few weeks in 1892?—That is so.

7337. Has there been any difference in the acid during those years?—Until the end of 1891 the acid was made from brimstone, but after that it was made for a period from pyrites, followed by an interval of three years, during which it was made from brimstone, and since then from pyrites.

Pyrites acid
commercially
represented
as being
made from
brimstone.

7338. What was the cause of your changing the source of your acid?—It was clearly understood that the acid which we used should be made from brimstone, and towards the end of 1891 the manager of Gibbs and Company called upon me, and said he was very sorry, but he could not supply me any longer with brimstone-made acid as the demand for that acid has declined so much that it did not pay to make it. He proposed to substitute an acid made from pyrites, which he guaranteed should be equally as pure as the brimstone-made acid. In fact, he said that he might have sent me that acid without my knowing anything about it, it was so pure. But he, knowing that I had this predilection for brimstone-made acid, thought it only fair to tell me he was about to discontinue its manufacture.

7339. You did not accede to that, I believe?—I was very nervous about using that acid, because I quite realised the tainted source from which it was made, and I preferred, if possible, to continue to use the brimstone-made acid. In the end I was obliged to leave Gibbs and Company because the manager said he could not supply me with any other kind of acid than that made from pyrites. Accordingly I ultimately got a supply from Messrs. Wallace and Company, who undertook to give me the acid I wanted.

7340. You subsequently found out that Messrs. Wallace and Company were not supplying brimstone acid?—Yes, in a few weeks' time the same manager of

Gibbs and Company called upon me, and said that he presumed the acid we had been using was satisfactory since we left them, or he would probably have heard from me. He said he thought it only fair to state that the acid which Wallace and Company were supplying to us was bought from him, the manager of Gibbs and Company, and sold to us as brimstone acid. On learning this I lost confidence in Wallace and Co., and accordingly went back to Gibbs. I had more confidence in Gibbs and Company than Wallace, especially after that incident.

7341. Did you ever find that the acid that you got through Messrs. Wallace contained any arsenic?—No, it was quite as pure as the acid we used before.

7342. Had you any guarantee, when you went back to Messrs. Gibbs? Did you ask them to give you a guarantee as to the purity of their acid?—No, I was satisfied. I have shown that I had every reason to repose the utmost confidence in Messrs. Gibbs. The manager came to me after the change, and told me frankly he could not supply brimstone-made acid, and accordingly I felt that I could have the same confidence in him as I had before.

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7343. Subsequently you had some further trouble?—I was always nervous about the pyrites acid, and I pressed him to make it from brimstone if he could, and he wrote me a letter saying he was about to resume deliveries of brimstone-made acid, and for about three years from that date he supplied me with that, but there was no obligation on his part to do so. He knew of my predilection.

7344. (Chairman.) Towards the end of 1898 I believe Messrs. Gibbs and Co. intimated to you that they were going to discontinue the manufacture themselves of sulphuric acid?—Yes, they said they were about to give up making acid, but they undertook to supply me with an acid of equal quality to their own make, made by the well-known firm of Spence, Chapman, and Messell, acid just as pure as that which had been supplied by Messrs. Gibbs and Co. But I did not know the people, and I thought it would be better to have a guarantee.

7345. In that matter Gibbs and Co. were only acting as agents for Spencer, Chapman and Messell?—Yes; I did not know Chapman's then, but I have known them since, and I know them to be a firm of the highest repute; but I thought it was as well to have a written guarantee that the acid should be free from arsenic.

E. G. 7346. With Messrs. Spencer, Chapman and Messell
you have made yearly contracts?—I have made them with
Gibbs and Co., but I knew soon after we commenced to
use the other acid that it was Spencer, Chapman and
Messell's, and since then for the last three years I have
had this guarantee that it should be free from arsenic.

7347. And the guarantee is worded as follows, I think.
"Guaranteed free from arsenic, iron, and nitrogenous
compounds?"—Yes, I have the contract here. I have
also an earlier one than that. I hand you the first con-
tract, dated 7th December, 1898. (Handed in.)

Corr.

London, E.C., 7th December, 1898.
Contract No. 4,874.

Messrs. The Manbré Saccharine Co., Ltd.,
Hammersmith, W.

We have this day sold to you the undermentioned
goods:—

Quantity.—Your total requirements from 1st Decem-
ber, 1898, until 31st December, 1899.

Goods.—Sulphuric acid, 70 per cent., guaranteed free
from arsenic, iron and nitrogenous compounds.

Price.—Forty-two shillings and sixpence per ton.

Delivery.—As required, in vanloads delivered to your
works in carboys.

Payment.—Monthly account, less 2½ per cent. discount.

Conditions.—Customary. Carboys to be returned
from time to time or paid for as may be arranged.

Yours faithfully,

JAMES GIBBS AND CO.,

(Sd.) L. E. Strong,

Secretary.

7348. The guarantee in the contract for the current
year is worded, "Guaranteed practically free from ar-
senic"?—Yes.

7349. The one which you hand in says, "We have this
day sold you the undermentioned goods, sulphuric acid,
70 per cent., guaranteed free from arsenic, iron, and ni-
trogenous compounds"?—Yes, that is so.

7350. It says, "Delivered in vanloads to your works
in carboys"?—Yes, and the other contracts have been
worded in the same way, except the present contract,
which is worded slightly differently.

7351. Did you take any steps to check the deliveries
yourself?—Yes, we tested them occasionally.

7352. And did you ever find that the substance con-
tained arsenic?—No.

7353. Upon learning of the accidents that had hap-
pened in Manchester, did you take any particular steps?
—We at once examined first of all every particle of
sugar that we had in our works also all the sugar which
we had in the depôts, because we thought it better to
make doubly sure that there was no possibility of any of
our sugar being contaminated. We examined every
pound of sugar that we had in the place, not only in the
factory but in the various depôts, and the same with
regard to our customers' stocks, for they had several
hundreds of tons at that time. It was all tested.

7354. And you found none of it contaminated?—None
at all.

7355. Therefore, in your opinion, with proper care,
there is no risk of the invert sugar being contaminated?
—Absolutely none whatever. In the first place, since
this outbreak of poisoning we examine every carboy of
acid, and although we were particular before,—of
course, everybody else is now—we are more particular
than ever. With a precaution of that kind, which,
after all, is only common sense and easily done, there can
be no possibility whatever of contamination. I should
like to mention, while I think of it, if I may be allowed
to do so, that I understand Mr. Garton, in his evidence,
before you, has stated that as large a percentage of acid
is used as 8 per cent. in the conversion of glucose. I
think he must have been mis-reported, or that he must
have made some error, because it is a most important
point. We can effect our conversion with less than 2
per cent.

7356. That is of invert sugar?—No, of glucose.

7357. What pressure do you use?—We use 60 to 65
pounds.

7358. The amount of pressure makes a considerable
difference?—Yes, but our process was at one time a

4576.

patent, it is a high conversion process, and by that
means we are enabled to use the minimum amount of
acid, and I can state that we never exceed 2 per cent.

7359. (Professor Thorpe.) The amount of acid depends
on the purity of the starch that you start with, does it
not?—Of course, the purer the starch, the less acid. If
we could use quite a pure starch we could do it with less
than that quantity; but taking all the materials we use,
our percentage comes out very much less than was stated
to you by Mr. Garton.

7360. You use pure starch?—We use the purest we can
get, but I thought it best to correct the statement of Mr.
Garton, because it is rather misleading if people get the
idea that an inordinate quantity of acid is used, which
may or may not be tainted. Such a statement naturally
adds to the degree of scare in the public mind.

7361. When Mr. Garton was giving his evidence I
might say he was comprehending the whole of the
trade. I believe he told us he himself used a special
character of starch material, and as a matter of
individual practice it is only very exceptionally that he
used so large an amount of acid as he indicated?—I
think it only fair to say that we at any rate have never
exceeded 2 per cent.

7362. But in the case of making glucose direct from
maize, is it not the practice to use a larger amount?—It
is not made from maize direct. I draw a distinction
between maize and maize starch.

7363. But I think glucose is made from maize directly,
is it not?—I do not think it is made directly from maize.
The only people who used it in that way were Johnsons'
Saccharum Company; and they commenced by making
it direct from the grain, but they had to abandon that
because it was more or less of a failure.

7364. Is it a fact that when you make glucose from
second grade tapioca, you require more acid?—In our
particular case we never use more than two per cent.

7365. Do you exclusively use sago and tapioca?—
No, not exclusively; we use sago, tapioca, and maize
starch.

7366. (Mr. Cosmo Bonsor.) Do you use rice-starch?—
No, not rice.

7367. Do you use Sarawak flour?—Yes, we use that
too. As far as my experience goes, whatever material
you may use I cannot see the necessity for using such
inordinate quantities of acid as 8 per cent. I thought
it probable that Mr. Garton had fallen into error, or
that he had been misreported.

7368. (Chairman.) Do you wish the Commission to
understand that you in your works use not more than
2 per cent. of acid? Of course we know that you use
a considerable amount of steam pressure?—Yes, we use
probably a higher pressure than anybody else. Our
plant was so arranged, and it was a patent under which
we worked years ago. We have maintained that plant
ever since. It is a high conversion, and a more rapid
process than one at a lower temperature.

7369. What you want us to understand is that, in your
opinion, in the manufacture of glucose there is no valid
reason why such a high percentage of acid should be
used?—I do. I rather want to make a point of that.

7370. (Professor Thorpe.) You have made it clear to
us what you understand by brimstone acid?—Yes, I
mean acid made from pure brimstone, not pyrites.

7371. Would the acid made from recovered sulphur
be to your mind brimstone acid?—No, nothing would
convey the idea to my mind that it was brimstone-
made acid unless it were made from sulphur.

7372. Recovered sulphur?—I should not regard that
as brimstone-made acid.

7373. You mean the native product then, I suppose?—
Yes, Sicilian sulphur, uncombined with any other
material. I should imagine, according to my simple
understanding—though people may take different
views, perhaps—that brimstone acid would be made
from that source alone.

7374. Would you understand by that, acid made from
Sicilian brimstone?—Yes, I would. I do not mean to
say that acid as pure cannot be made from other ma-
terial. The acid we use is made from pyrites. I have
since the scare, especially knowing the prejudice exist-
ing, tried to get a supply of brimstone-made acid, not
because I think it is any better, but simply on account
of the prejudice, if you like to call it so, which exists
against the use of pyrites-made acid. I have tested en-
dless samples of brimstone acid, but I have never found

Mr. E. G.
Francis.

10 May 1901.

Glucose not
made direct
from maize.

Brimstone
acid should
mean acid
from natural
sulphur.

Mr. E. G.
Francis.
10 May 1901.

acid so pure, on the whole, as the acid which I am using now, made from pyrites.

7375. In the case of brimstone acid no particular pains would be taken to free it from arsenic?—That is so. I do not think a man who gets acid made from brimstone would look at it so closely as acid made from pyrites.

Pyrites acid may be better than arsenic than brimstone acid.

7376. Is it your idea that by virtue of the purification which would have to be gone through in the case of acid made from pyrites, it would be a purer product than the brimstone-made acid?—I am sure of it. Knowing as much as I do about it, and knowing that I am now dealing with a firm of repute, I feel safer in using that acid than any acid made from brimstone, assuming that we did not look into it as closely as we do. On that assumption I can see the possibility of brimstone acid containing minute traces of arsenic.

7377. (Mr. Cosmo Bonsor.) Which test do you use?—Marsh's.

7378. Entirely?—Yes.

7379. I understood you to say you were prepared to give a guarantee with your goods?—We do.

7380. A guarantee that they are absolutely free from arsenic?—We do; we state it on each invoice.

7381. Are you prepared to agree that that guarantee should be checked by a Public Department after the goods are delivered?—Yes, I believe it is checked by our customers.

7382. By the brewers or by the Public Authority?—Certainly. I should be only too pleased for it to be checked.

Form of guarantee by signed by anybody, or is it a general guarantee?—We print it now on the invoice. We used to write a letter previously to each customer, giving the guarantee, but we find that customers are satisfied with a guarantee printed on the invoice. It says, "We guarantee the above goods free from arsenic." They are satisfied with that.

7383. (Professor Thorpe.) But is your guarantee signed by anybody, or is it a general guarantee?—We print it now on the invoice. We used to write a letter previously to each customer, giving the guarantee, but we find that customers are satisfied with a guarantee printed on the invoice. It says, "We guarantee the above goods free from arsenic." They are satisfied with that.

7384. At your works you have a chemist, I suppose?—Yes, we have three.

7385. So you do your own testing?—Yes, all the operations are tested.

Records of tests kept since the epidemic.

7386. (Dr. Whitelegge.) Do you keep a record of the analyses made?—We do now. We did not before, but now we keep a record of all the tests we make.

7387. You keep a record whether the results are positive or negative?—Yes.

7388. Prior to 1891 you were aware of the danger from arsenic?—I was always aware of the danger of arsenic being in acid, especially that made from pyrites.

7389. It was a matter of common knowledge?—Yes.

7390. Was there any question of arsenic involved in that temporary change from Messrs. Gibbs to the other firm?—I was afraid of it, and preferred brimstone acid.

7391. You told us that during a period of three years, 1894-6 inclusive, a reversion was made to sulphur-made acid?—I had always a prejudice, if you like to call it so, in favour of brimstone-made acid.

7392. Can you tell us whether that intermediate change was due to any suspicion of arsenic?—No, it was not; there was no question of arsenic.

7393. You make brewing sugars, I suppose?—Yes.

7394. Glucose and invert sugar; nothing else?—Yes, and caramel.

7395. Do you supply to brewers direct?—We do.

7396. Do you supply to any other persons?—No, we deal solely with brewers, with the exception of a few tons occasionally to a dealer. But our trade is directly with brewers, you may say, almost entirely.

7397. And you have no knowledge of the sugars you make passing into other hands for industrial purposes or for making jams or syrups?—No, it would not do for making jam, because it is solid glucose; liquid glucose is used for that.

7398. You do not know of any other industrial application of it?—Only brewing.

7399. What about textile manufactures?—No, it would be too dear for them.

7400. (Chairman.) You said you did not know of any other industrial application. We have just heard from another witness that some of Bostock's invert sugars and glucose has been sold for the purpose of calico dressing?—I have never known it used for that, but I have known it used for giving a fictitious weight to leather. Our stuff is too dear for purposes of that kind. It is a commoner kind which is used for that purpose. I have not heard of any other industrial use of it.

7401. (Mr. Cosmo Bonsor.) You said just now that you made glucose, invert sugar, and caramel. Have you made any maize flakes?—Oh, yes, we have; we do make that too.

7402. Do you use any acid for the purpose?—No, none at all.

7403. Could you give, in a few words, a description of the process from maize?—Yes, we purify it to free it from germs and husk, then reduce it to grits; these grits are then gelatinised and passed through rollers, and the result is flakes. The flakes are then dried in dryers, after passing through these rollers. There is no acid used in the manufacture at all.

7404. So there is no opportunity of contamination?—There is no possibility whatever of contamination, none whatever.

7405. Would you mind our seeing one of your invoices?—Certainly. You will see that it is an invoice specifying the goods in writing in the ordinary way, and that below the specification, at the foot of the invoice, we print: "We guarantee the above goods free from arsenic."

7406. (Chairman.) I believe you are the Managing Director of the Nord-Deutsche Kartoffel-Mehl Fabrik, Ltd., of Custrin, Prussia?—Yes.

7407. Although the Limited Company only dates from 1901 it is a very old business, I believe?—The Company was formed in 1870, upwards of 30 years ago. Before then my father and my grandfather were manufacturers on the Rhine.

7408. You make, I believe, three principal products, purified starch or farina, dextrine, and glucose?—Yes.

7409. The first is manufactured for the purpose of making the other two?—Yes, that is so.

7410. What is the farina, dextrine and glucose which you manufacture chiefly used for?—Farina is used partly for food purposes and also in the textile, paper, and other industries. It is very largely used in Manchester, and for similar purposes all over the world.

7411. For giving body to calicoes?—For sizing and for foodstuffs. It is very largely used in making macaroni and for thickening sauces. It is very largely used for vermicelli in Spain and also in Italy for the same purpose.

7412. What is the farina, chiefly prepared from?—From potatoes.

7413. The amount which you manufacture is, I believe, very large?—Yes.

7414. Will you give the Commission some idea of the amount of farina which you annually manufacture?—It varies very much according to the crop. When the crop is abundant the sales vary accordingly; but on an average, I think about 20,000 tons of farina alone is our quantity.

7415. You estimate that the whole manufacture of the material amounts to something like 250,000 tons a year?—That is a bold guess; but taking into consideration that Germany, Holland and France are about the only countries in which farina is manufactured in large quantities, we can form an idea that this is about the correct quantity. We cannot say whether it is absolutely correct, as we have no statistics on that point.

7416. Is the term farina exclusively applied to potato starch?—Yes, I should say so. Farina is also called potato flour and potato starch.

7417. (Professor Thorpe.) Maize starch is never called farina, is it?—I have never heard it called so.

7418. (Chairman.) The preparation and purification

MR. RUDOLF FREDERICK WAHL (Managing Director, Nord-Deutsche Kartoffel-Mehl Fabrik, Ltd., of Custrin, Prussia), called; and Examined.

Mr. R. F. Wahl.

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Mr. E. Francis.
10 May, 1901.

Manufacture is almost entirely by brewers.

too dear for textile purposes, &c.

No acid in flaked maize.

Mr. R. F. Wahl.

of farina is purely and solely by mechanical means; no chemicals are used at all, I believe?—No, no chemicals are used. We never use chemicals for it.

1901. 7419. You say you never do?—No.

7420. I suppose you have never heard the wholesomeness of farina manufactured from potatoes called in question?—Never.

7421. It is quite freed from nitrogenous matters?—Oh yes, I have brought you some samples of farina which are our products. (The witness handed samples to the Commission.)

7422. How do you make the dextrine from your farina?—By calcining with the use of acid, with a very small addition of acid.

7423. (Professor Thorpe.) What acid?—Nitric acid.

7424. (Chairman.) That is not used in any way as a foodstuff?—Never.

7425. It is required for what material?—Also for textile purposes and for mixing with colours for paper-hangers, and for coating labels, for gummed papers, and so on.

7426. It is the basis of most of the gums in use, I believe?—Yes.

7427. The commoner gums, of course?—Yes; the commoner gums.

7428. That is, comparatively speaking, a very small part of your manufacture of dextrine?—It is not so very small; we make about 5,000 or 6,000 tons of that a year; that is, of dextrine. That is also largely used all over the world; it is used in England, and goes to America, Spain, and Italy. Of course, Germany is our principal market.

7429. Your glucose is used, I suppose, almost entirely as a foodstuff?—Not entirely. I was listening to what was said before, and I may say that in Germany it is used occasionally for textile manufactures, and also for paper-making. In this country it is not so much used for the textile industry.

7430. (Mr. Cosmo Bonsor.) Do you refer to glucose?—Yes, glucose.

7431. (Chairman.) How do you make your glucose?—We make it with brimstone acid, and in the usual way, that is, with pressure. I have been hearing what was said about the percentage of acid used, and I can only say we use considerably less than that which has been stated in this room as the lowest quantity.

7432. Do you mean less than two per cent.?—Yes; considerably less.

7433. Mr. Francis said he used considerably less?—Yes, but we use less than one-half.

7434. Do you use very high pressure?—Not very high.

7435. He told us what pressure he used; do you object to telling us what pressure you use?—I do not mind saying we use two atmospheres; that is 28 lbs. to the square inch. Of course, for liquid glucose less acid is used than for solid glucose.

7436. (Professor Thorpe.) All your glucose, I suppose, is made from purified potato starch?—Yes.

7437. Short of water, it is 99 per cent. of starch, with very little ash in it, I suppose?—Yes.

7438. It is a product which should be converted with a theoretical minimum quantity of acid?—That is so. You have the starch in front of you.

7439. (Chairman.) And the purer the starch the less the percentage of sulphuric acid necessary?—Yes; but it is not only purity, but consistency which is aimed at. If you boil starch which is very thin, and take three parts of water to one part of starch, you require more acid than if you have a very condensed liquid starch to deal with.

7440. Do you know what your glucose is chiefly used for in the matter of foodstuffs?—Yes; in Germany it is largely used for brewing, and also for the improvement of wines.

7441. Do you know what proportion the German brewers use the glucose in?—I could not say.

7442. Nor the wine makers?—No, I do not know anything about that.

7443. I think it is not only used in Germany for wine making, but also in France and Italy?—In France very largely, certainly.

7444. (Mr. Cosmo Bonsor.) For champagne?—No, it

cannot be used for champagne. I daresay it has been tried, but glucose is not adaptable for champagne making, but for clarets it is used to a large extent.

7445. (Professor Thorpe.) You say it is used for the improvement of wine. How does the addition of glucose improve the wine?—It is used for the improvement of inferior vintages. When there is little sun in the summer and the grapes are very sour, sugar is added to decrease the acidity of the grape, and the added sugar helps to get the alcoholic strength.

7446. (Chairman.) Its use is prohibited, I think, in Bavaria, Wurtemberg, and Baden, is it?—Yes, for brewing purposes.

7447. Why?—For political purposes. I suppose the Farmers' League has got a very strong hold, or strong representation in their Parliaments, and thus it has been brought about that it is prohibited.

7448. They have prohibited any substitute for malt in brewing, I believe?—Yes, they have prohibited any substitutes, although it is publicly known that they do use substitutes—they smuggle them in in Bavaria.

7449. Still, we do not recognise the breaking of the law here?—Well, we do not sell any to those countries for purposes for which they are prohibited.

7450. Can you, of your own knowledge, inform us that it is the law in Bavaria, Wurtemberg and Baden that no malt substitute should be used for brewing?—Yes, but that does not refer to wine. Bavaria is not a wine-growing country, but in Wurtemberg they make wine from fruit, such as apples and pears, and for cider it is very largely used.

7451. (Professor Thorpe.) There is a certain amount of wine-growing in Baden, I believe?—Yes.

7452. Is glucose used in conjunction with the wine industry in Baden?—Yes, as far as I know.

7453. (Chairman.) You inform the Commission that 10,000 tons, or not less than 10,000 tons are used in Germany alone?—Yes.

7454. For beer and wine?—Yes, quite so.

7455. Not less than 6,000 tons employed in German breweries for the years 1898 and 1899?—Yes, and the consumption is increasing.

7456. Is there by law any restriction in Germany to the amount of glucose in beer?—I should not think so.

7457. No restriction at all?—I think not.

7458. Do you know at all what is the average amount added to the malt?—I could not say.

7459. You say in common with rice, which is largely used in Germany, its use is recognised and regulated. I thought you might be able to tell us what the regulation was?—It is simply regulated by the excise duty which is paid on glucose in beer making. The brewers have to pay.

7460. The Government in Germany reckon so much which pay glucose as the equivalent of so much malt, do they?—duty on I do not know how they reckon it. I know there is a glucose duty, amounting, I think, to 8s. per 100 kilos, equal to used. about 4s. per cwt. on glucose.

7461. (Dr. Whitelegge.) Do you refer to glucose used in brewing, or to glucose generally?—I refer to brewing.

7462. There is no duty on glucose as such?—No.

7463. (Mr. Cosmo Bonsor.) Could you tell us whether in those countries where glucose is forbidden to be used for brewing, beer brewed from glucose is also prohibited from being imported?—It is not prohibited from importation.

7464. So you could import beer brewed from it, though you are not allowed to brew from it?—Yes, but in their own country people drink their own beer generally.

7465. (Professor Thorpe.) I suppose importing beer into Bavaria would be something like carrying coals to Newcastle?—Yes.

7466. (Mr. Cosmo Bonsor.) It is only a question of law?—There is no restriction on that, I think.

7467. (Chairman.) Do you use sulphuric acid?—Yes.

7468. For dextrine you use nitric acid?—Yes.

7469. What is the source of your sulphuric acid?—We get it from Stettin, from one of the first chemical works in Germany. We have got it from Stettin for the last 30 years, ever since we started as a limited company.

Mr.
R. F. Wain.
10 May 1901.

Use pro-
hibited in
Bavarian
beer.

Quantity of
glucose used
in German
breweries

Mr.
R. F. Wahl.
10 May 1901.

Acid guaran-
teed free
from arsenic
used in
German
glucose.

but not
tested by
glucose
makers until
recently.

Small use of
liquid
German
glucose in
England.

Bleached
by sul-
phurous acid.

7470. Do you require a guarantee with it?—We always get it. I have brought five invoices as specimens for you to see, dated 1895, 1896, and 1900, all before the scare.

7471. You have yearly contracts, I believe?—Yes. These are the invoices. It is always stated to be free from arsenic, and we have got a factory—a small factory—in Baden, in the neighbourhood of Karlsruhe, where we also manufacture a small quantity of glucose. In order to be absolutely certain that we get pure sulphuric acid we get it sent from Stettin to that place, which means a journey through the whole of Germany, at a very considerable cost. This cost enhances the cost of sulphuric acid by 50 per cent. You will notice there, sir, one invoice embracing the freight, and from the note at the side you will see that the freight comes to half as much again as the sulphuric acid.

7472. Do you specify what the acid is to be?—Free from arsenic.

7473. You say here the acid is made from Sicilian brimstone?—That is so. We have been assured it is made from Sicilian brimstone.

7474. Does it mean purified acid?—It means made from sulphur imported from Sicily.

7475. At Stettin?—At Stettin.

7476. (Chairman.) You formerly did not test the acid yourself?—We did not before, but since the epidemic we test every carboy of acid that comes into our place.

7477. Have you found any of it contaminated?—No.

7478. You have not had to reject any?—No, not sulphuric acid.

7479. Do you ever test your product too?—Always, every day, we test it not only when it is finished, but also in the progress of manufacture. The tests we use are Gutzeit and Marsh.

7480. Are Messrs. Julius Franks and Ohlman your agents in this country?—Yes, for the solid glucose.

7481. And you have no objection in your trade in giving the guarantees of purity to your customers?—Certainly not.

7482. I think you heard the last witness's evidence?—Yes.

7483. Do you agree with him as to the greater purity of purified pyrites acid over brimstone acid?—I do not know so much about that, but we guard ourselves by testing every carboy, and here is the result of one of our tests. Here is the Marsh tube. We also test all the sulphuric acid we get delivered, and there is not the slightest sign on this tube, as you see. This is made with 25 grammes.

7484. Is any supervision exercised by Government, or have they any control over the materials which you use, or is that left entirely to your own judgment?—That is left to us.

7485. Do you yourself make caramel?—Yes.

7486. And what is caramel used for?—For colouring purposes, mostly for beer, vinegar, and spirits.

7487. You do not, I suppose, know whether your agents in England supply their sugars to other than brewers?—No, we do not know.

7488. Do you think that any large quantity is used for confectionery or jam-making?—The liquid glucose, yes. I have brought you a sample of that. (Sample shown.)

7489. Do you import a large quantity of liquid glucose into England?—Not very much. It comes to 500 or 600 tons in a year. It used to be much larger, but since the American competition came we cannot compete so well, because our articles are considerably dearer than others. People pay for their good quality.

7490. Is this liquid glucose much used on the Continent for making fruit syrups?—Enormously; a very much larger quantity than of dry glucose.

7491. (Professor Thorpe.) That glucose you have brought us is bleached now?—It is purified by charcoal.

7492. Is it not bleached with the use of sulphurous acid or sulphites?—To a very small extent. It runs out of the filters like this.

7493. Is there such an amount of sulphurous acid in it as precludes it from being used in brewing?—Certainly not.

7494. Are there many makers of these products in Germany?—Yes.

7495. How does your firm compare, in point of magnitude, with others?—It is by a long way the largest.

7496. Do the other firms, too, send their products to England, do you know?—Not in later years, or to a very small extent only. We know it by statistics. I understand you to be only speaking of glucose now?

7497. Yes?—Nearly all the glucose which comes to this country comes from us.

7498. Has your attention been called to some statements as to the occurrence of arsenic in German-made glucose, on the authority of Dr. Ritter?—No.

7499. You have not heard, for example, that as far back as 1878 attention was called to the occurrence of arsenic in German-made glucose?—I remember it at the time, but it has never been proved. That was at the time when our glucose and all sorts of glucoses had been examined by the Reichsgesundheitsamt, in Berlin; but it has never been followed up nor mentioned since.

7500. Not in Germany?—Not in Germany.

7501. You are not aware that the matter was substantiated, as far as the French glucoses are concerned, by Professor Clouet?—I am not aware of it.

7502. It is news to you, then, that German glucose could contain arsenic?—It is.

7503. Are your agents in Liverpool?—No, in London.

7504. Are they agents for any other makers of this material? Or are they general agents?—They may sell other glucoses—that I do not know. They are practically buyers from us, not what you call agents, people working on commission.

7505. They buy from you to resell?—Yes.

7506. They may very likely buy from other makers?—I should not think they buy from German makers, but they may buy American glucoses.

7507. Do they buy invert from you?—We do not make invert. These which I hand to you are the only glucoses we make. (Samples shown the Commission.)

7508. (Mr. Cosmo Bonsor.) You invoice to them, and not to the brewer?—We never sell to the brewer.

7509. You really do not know the brewer?—We do not.

7510. What if they make a bad debt?—That is their business.

7511. Not your business?—No.

7512. (Professor Thorpe.) What amount of water does this glucose contain?—12 to 13 per cent.

7513. Is it fairly uniform in the proportion of water which it contains?—Yes, it is made of the same strength, almost exactly the same.

7514. The process of your manufacture is such that you ensure it shall contain 12 to 13 per cent.?—Yes, it is always weighed.

7515. Do you imagine yours is dryer than English made glucose?—I should say it is about the same.

7516. The other form of glucose also contains the same amount of water?—Slightly more.

7517. The white contains slightly more?—Slightly more, but that is only a question as to how it is asked for. We make glucose for export to Australia with a considerably less quantity of water in than that.

7518. What is the amount which this sample contains?—About 15 per cent.

7519. And that which you send to Australia—how dry is that?—About 11 per cent.

7520. (Mr. Cosmo Bonsor.) You state that you have no objection to giving a guarantee with your goods to the agents?—Certainly not.

7521. And you would have no objection to the Customs, I presume, being the check upon that guarantee?—Certainly not. I am assuming that the materials used by the different chemists for testing are absolutely pure, because it has very often been found and proved that the materials are not pure. We ourselves have been trying very hard to get the purest materials possible—for example, zinc for the Marsh test. We have examined the zinc and found—I do not know whether it could be called a trace—of arsenic, but there was a

Mr.
R. F. W.
10 May 1

is consi-
to agents
not to be
direct.

Mr. little white circle round the tube, even with the purest materials we could obtain over there.

Wahl. 7522. Has it ever come to your knowledge that saccharine has been mixed with glucose for the purpose of giving added sweetness to it?—We have never done so.

7523. Has it come to your knowledge?—It has come to my knowledge that it has been done in this country. In Germany the use of saccharine has been altogether prohibited since about twelve months ago.

7524. The use of saccharine has?—Yes, except that it can only be bought from pharmaceutical chemists; it cannot be bought in bulk. I may mention that the samples I have brought are not made up for the Commission. They are average trade samples.

7525. (Dr. Whitelegge.) Do you use only potato starch?—Only potato starch.

7526. And from that you make both solid and liquid glucose?—Yes.

7527. Will you tell us, briefly, what is the distinction between the two?—Do you mean between the solid and the liquid?

7528. Yes?—Liquid glucose is the first stage. Liquid glucose is not boiled so far that it crystallises. It is a between product.

7529. But by further treatment liquid glucose would yield solid?—Yes, it would turn solid. Liquid glucose may turn solid afterwards if by any mistake it is carried a little too far.

7530. Liquid glucose is cheaper?—No; on the contrary, it is rather dearer, because the package is dearer. It is supplied in big casks, and they are expensive. Also, in consistency it is very thick. Here is the strongest consistency.

7531. (Professor Thorpe.) What is the actual amount of sugar in this sample?—I should say about 40 per cent.

7532. (Dr. Whitelegge.) Are both used in brewing?—The liquid form is not used in this country, to my knowledge, for brewing, but it is used largely in America. We used to ship large quantities to America in former times, before the maize glucose was invented, and I have been informed it has been used for brewers mostly.

7533. Would other kinds be used in wine?—You could not use liquid glucose in wine.

7534. The glucose used in brewing in North Germany is the solid?—It is solid.

7535. Is that used in brewing beer similar to Bavarian beer?—It is more used for the top fermentation beer.

7536. Would it not be suitable for the other?—I do not know, but I believe it would.

7537. Is there any Government inspection of your factory in Germany?—Oh, yes.

7538. Any special inspection by reason of glucose being made?—No.

7539. Simply the ordinary application of a Factory Act?—That is it.

7540. You told us that you have found no arsenic in the sulphuric acid?—No.

7541. Does that mean absolute freedom from arsenic?—Absolute freedom.

7542. Not even traces have been found?—Not even traces.

7543. You limited your answer to the sulphuric acid. May we take it that in other acid arsenic has been found? Had you in mind the discovery of other kinds?—Hydrochloric and nitric. I have not examined them.

7544. You have not found arsenic in any acids?—In hydrochloric, to my knowledge, small traces of arsenic have been found.

7545. Was that supplied on a guarantee in the same way?—Only purified hydrochloric acid.

7546. It was not said to be free from arsenic?—No; because that is used for the purification and cleaning of charcoal. Will you let me say a few more words? It has been stated that potato starch, in its conversion into glucose, produces a deleterious substance called gallisin, which is an unfermentable matter. I wanted to hand in a paper to show it is untrue, and that it has been proved by eminent chemists and physiologists that it is an absolutely harmless substance. I have brought here a paper and literature dealing with this subject.

7547. (Chairman.) Do you say your manufacture is exclusively from starch of your own making?—Yes.

7548. We have heard from other makers of glucose that there is a danger in using some of these meals; invariably that you do get nitrogenous compounds which are offensive, if not dangerous?—Yes. Well, we are excluded from using anything but potato starch, on account of the very high duty in Germany on other imported starches, like tapioca, rice, and sago flour. There is a duty of about £8 or £9 a ton, which renders it prohibitive for us to use these starches.

7549. Is there not very considerable difficulty in freeing potato starch from other matters?—It is not nearly as difficult as from maize, but by careful manufacture it is made as pure as you see it there.

7550. Made pure by purely mechanical processes such as grinding and washing?—Yes, grinding and washing.

7551. If not purified, I think potato starch would when treated, give origin to a considerable amount of offensive matter?—I should think so. I do not think anybody would use potato starch for glucose making without it was cleaned. They could not very well. The potato water has to be got out of the potato first before the starch settles down.

7552. (Professor Thorpe.) What is the particular mode of treatment which enables you to get this white as compared with greyish colour?—The white is the original product, and the yellowish colour is made to people's fancy. It is simply a matter of fancy. Most people in this country prefer the yellow to the white. In Germany we sell the white. We also send white to this country, but yellow to a greater extent. The yellow is not a second quality; that is, it is the same pure quality as the white, only treated differently.

7553. But containing a slightly different percentage of water?—Slightly less. That is only a matter of detail. If they would like to have it stronger and pay a higher price we should be pleased to do it.

7554. Could you tell us whether it would be possible to determine that that was made from farina or from pure tapioca, or whether it was made from pearl starch? Would not pearl starch and farina yield identical products?—I think in pearl starch—which I understand is maize starch—you might find a small percentage of converted gluten by the aid of acid, and you would always find a trace of phosphoric acid in sugar made from maize too, as far as I know.

7555. Is there no phosphoric acid in this?—No. In my experience potato and farina starches are the purest you can have. It does not contain gluten, which maize starch does.

7556. You think it might be possible to differentiate between the various glucoses?—I never tried it. It might be possible. But I shall be pleased to let you know. I will ask our chemist to make experiments; I daresay he can let me know.*

7557. I should personally like to know how it might be possible to detect the origin of any particular form of glucose. It would be very useful to know.

(Mr. Cosmo Bonsor.) It would be very useful to detect the origin of beer in the same way.

* Note by Witness.—Our chemist, whom I have consulted, writes that he considers it is not possible with any claim to absolute accuracy to find out by analysis whether glucose was made from farina, maize, starch, tapioca, or sago, or any other flours.

Mr.
R. F. Wahl
10 May 1901.

Potato starch
contains no
gluten.

Mr. WALTER W. BERRY, called; and Examined.

Mr. W. W. Berry.
10 May 1901.

7558. (Chairman.) You have, I think, had large experience in the growing of hops?—I have grown hops all my life.

7559. On a large scale?—Fairly large, yes.

7560. (Mr. Cosmo Benson.) You do grow hops, and you also sell other growers' hops?—Yes, but I only sell the hops which I am interested in. Part of my business is my own and part of my mother's. I sell hops in my own name.

7561. You manage other people's hops?—No; I am called in for advice professionally, but I do not control any other growths but those of my own family.

7562. (Chairman.) Perhaps you will have the kindness to inform the Commission upon the systems in use in growing hops, so far as it bears upon this question. I do not think we need go into the preparation of the land, or the planting of the hops, but rather the growth of the hop each year?—Your desire, I understand, is to know in what way chemicals are used in the growth?

Hop insecticides, soft soap and quassia,

7563. At what time of the year do you generally commence spraying with insecticides; when do you commence washing the hops?—I shall be commencing to-morrow, so it will be fairly early in the season. It is on the appearance of certain insects that we commence to spray, to check the damage as early as possible. At the present time the bines are just shooting out of the ground, and the turnip flea has commenced to attack. The season being a late one, if the turnip fleas are persistent we get only a small quantity of bine. So we are endeavouring to check the spread of the insect. We are using a strong solution of soft soap and quassia, just to make the plant nasty, so that the insect will not eat it.

7564. Is the turnip flea the same beetle as attacks the turnip plant?—Yes.

7565. That is when the hops come out of the ground?—They attack the bines as soon as they see them.

7566. (Dr. Whitelegge.) Not later?—Yes; it is troublesome now. They do not blacken the plant as the aphid does, but they retard the growth.

7567. Will you tell us your address?—Gushmere Court, near Faversham.

7568. (Chairman.) At a later stage, when the hops get up, aphid is apt to appear?—Yes, and we spray vigorously to get rid of the aphid during the earlier stages, to keep the plant free, that it may grow freely, and to prevent the cones from getting damaged from the filth that arises from the aphid.

7569. What is used for spraying hops to get rid of aphid?—The principal ingredient is good quality soft soap. In all the washes that are used, soft soap is largely employed. Extract of quassia chip is also used to make the plant bitter, so that the young insects which we miss killing may not thrive on the plant. We find that although we kill the aphid, before it is dead, young ones are born, and we might miss the young ones. But if the plant is made bitter the little insects do not thrive on the plant. Clean quassia chip is used for that purpose, simply to make the plant bitter.

and other substances.

7570. Do you use anything else?—Great numbers of things are used. Many chemists are producing various things, but they are only used experimentally. I have used a wash called Spimo, which consists very largely of soft soap. There is also some quassia, and there may be some other ingredients of which I have no knowledge. But in use that is practically like my own. Not being a chemist, I cannot say what the other ingredients may be.

Paris green not applied to hops.

7571. So far as you know, chemical substances, such as Paris green, are not used?—Never used on hops; at least, I have never known it used. Paris green is only used on fruit, where altogether other kinds of insects have to be dealt with. It would be a great waste and an unnecessary expense to use Paris green in a hop garden.

7572. Is sulphur never used?—Sulphur is largely used. Dissolved sulphur is used in the wash, in quantities of about three or four pounds of dissolved sulphur to an acre of hops.

7573. Do you know what dissolved sulphur is?—Liver of sulphur.

7574. Is it dissolved with the soft soap?—No.

7575. Is it a soft soap solution?—No. What I call dissolved sulphur is this. We receive it as liver of sulphur, and that, in water, soon becomes quite liquid. But we do not attempt to dissolve ordinary sulphur ourselves.

7576. You would have a difficulty, I think?—We should have a difficulty in perfectly dissolving it, but I have assisted in some experiments to try and get it dissolved by the use of lime and acid; that is, to try and make a solution from the flowers of sulphur, but it is very difficult, and the results have not been very satisfactory.

7577. (Professor Thorpe.) You make your own solution of soft soap?—Yes, we buy soft soap by the ton and boil it, and add to that the liquor which we get from steeping quassia chip in moderately hot water for 24 hours.

7578. You never tried the effect of adding flowers of sulphur to the boiling soft soap solution, did you?—We put it in, but I have not done it for years. If we get an early attack of mildew in the hops, and when one washing has not affected it, we have tried this, but it was only done as an experiment, and we got no beneficial results.

7579. What do you think it is in the soft soap which protects the plant?—The alkali.

7580. You could use it as pure alkali just as well as in soap?—Yes. It is possible, but with the soap all the machinery works well. If you simply had alkali and water the machinery would not work well.

7581. (Chairman.) In the first attack of the aphid sulphur is very little used?—Yes. It is not used for aphid, it is only used for mould. And I would explain that, in the early days, when little was known by hop-growers of the disadvantages or advantages of sulphur, it was used carelessly. But to-day it is used carefully, and our system is to so treat the plant in its early stages as to keep it healthy, and so that the crop is clean. It is years since I have seen any quantity of mildew in the cones, and the brewers with whom we deal beg of us not to use sulphur when the cones are produced, but only in the earlier stages. It is impossible for sulphur very largely to get on to the plant at all.

7582. Therefore, I understand from you that it is almost impossible for any amount of sulphur to be present upon the flower of the hop?—Yes.

7583. Then it is not, as I think there is a common impression, dusted with dry preparations containing sulphur?—They are in certain instances. If a man sees his crop going he will make great effort to save it. But it is not necessary to use it in later stages.

7584. But when you get an attack of mildew when the bine is in flower, is it not the case that powders are used for sprinkling?—Yes, they are vigorously sulphured then. A man will make a great effort to avoid losing his crop, and as a last resort he will sulphur it. It used to be the system to do it always, to do it for the purposes of colour. But brewers have, and I think very wisely, declared that they will not attend so much to colour as they have done. Therefore we produce a much more natural article, and sulphur has dropped out of use.

7585. Still, in those cases where the burr is vigorously sulphured there might be a certain amount of sulphur powder remaining in the burr when it is gathered?—Yes, there might be in such a case, but those cases are very infrequent to what they used to be. I would like to explain the nature of the sulphur we use for this purpose. We use the best flowers of sulphur, sublimated Sicilian sulphurs. Other sulphurs it is impossible to use; they are not sufficiently light.

7586. The Kent farmer would not specify anything further than flowers of sulphur?—Yes; he would have one of two or three makes only, because such flowers of sulphur as are used for chemical purposes are not good for us, they are not sufficiently light. Hops grow ten to twenty feet high; our machine passes under the hops, and it is like a winnowing machine which winnows chaff out of corn. It winnows the sulphur into the air.

7587. The farmer would perhaps specify it should be in an extremely finely divided condition, but he does

Mr. B.
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10 May
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V. W. not specify that it should be of any guaranteed purity?
rry. —No; the question has never been raised until this
y 1901. season.

7588. Therefore, as you said, he would use Sicilian sulphur?—Yes.

al 7589. But, so far as you know, he probably would
r used. use sulphur obtained from the refuse of gas works?—
No; and for this reason. We buy sulphur for dusting
the plant with, and for purposes of stimulating a plant
which is flagging. We also buy what is called rolled
brimstone. That is purified rock brimstone, which
comes from the Mediterranean for bleaching purposes
in the kilns. We have always known that it was
necessary to have the purest and best quality we could
get for use in the kilns, not because we had any
chemical knowledge as to possibility of contamination,
but because, in producing such a valuable article as
good hop, we have felt it was necessary to buy the
best, inasmuch as a few shillings a ton is the only
difference in price between the ordinary and the best.
I have only known hop farmers buy the best. The
best sulphur is the Sicilian, and the firm who supply
seven-tenths of the whole are Brandram Brothers.
There are two or three others, whose sulphur I believe
is equally good.

7590. (Professor Thorpe.) Are this firm importers of sulphur?—I do not know anything about their business, except that they have a large business in sulphur. Whether they import it or buy it of shippers, I do not know.

7591. Do they deal exclusively in sulphur?—No; they manufacture white lead, and so on.

7592. Where is their place?—At Rotherhithe. When I was called upon to give evidence, I asked those with whom I trade if they would give me information, and they replied that the sulphur and soap are absolutely free from arsenic. In one case the man replied that he believed it always had been absolutely free from arsenic.

7593. (Chairman.) As a matter of fact, probably they had never looked for it?—I was going to suggest they believed it always had been, and this year they are sampling everything they send out, and find that there is absolute freedom from arsenic.

7594. You are able, of your own knowledge, to tell us that the sulphuring of hops with powdered sulphur only occurs in exceptional years to any extent?—Yes; and in an exceptional acre in a crop. It is an expensive operation, and brewers object to it, and therefore it is not done if it can be avoided. The brewers have said, "If you have any necessity to sulphur any portion of your crop, ear-mark that, that we may know." And very great care is taken.

7595. You have a great experience of methods of gathering and curing hops?—Yes.

7596. And you have already told us that best brimstone is used on the kilns for bleaching?—Yes.

7597. Is that largely or generally used?—Yes. But the quantity of sulphur used is very small; it is only necessary to use very little. I have used 2 lbs. of sulphur to a cwt. of hops. It is burnt in a pan.

7598. It is not thrown into the fire that is used at the bottom of the hop kilns?—I have seen it done in that way, but I do not adopt that plan myself; it is very wasteful, and you do not get rid of it. My plan is to have a pan into which the necessary quantity of sulphur is placed, and when the hops are first put on the kiln, full of natural moisture, this sulphur is burnt underneath it for two hours. Then there is no necessity for anything further. If you put the brimstone on the fire, it melts and all runs through on to the ashes below. When the manager of the kilns finds he is getting more heat than he wants, he puts ashes on to check the heat, and the sulphur which is not consumed he puts up, and there is constantly some sulphur. We absolutely burn out what we require to use.

7599. You take your pan away?—You cannot do that when it is burning.

7600. What fuel do you use?—We use the best Welsh anthracite. There again the best is the cheapest, because it is free from waste. We can burn 100 tons of best Welsh anthracite with less than 1 per cent. of ash.

7601. I am speaking of your own district generally?—I know of nothing being used in my district but anthracite from the best Welsh collieries. Years ago we used gas coke, but during my time never.

7602. Speaking of the district generally, gas coke is seldom used?—I have not heard of it being used in my own district, but I have heard that it is used in Worcestershire. Speaking generally, I have no knowledge of it.

7603. The fumes of the fuel pass through the hops?—Yes; hence the necessity of good anthracite coal.

7604. During all your experience, has anthracite coal been used, or do you remember the time when hop kilns were worked with charcoal?—We use a little charcoal now, but charcoal is used for hastening up the fire. For instance, if the heat is flagging, or if we get the hop discoloured by the change of wind and the draught is not regular, by putting on a few pounds of charcoal it helps to kindle the anthracite and keep the heat up steadily. A few bushels of charcoal are used in each kiln each season, but only for regulating the fire; not as coal is used, but only to assist the coal.

7605. Have you any views whether there should be any alterations made in the practice of either washing or cleaning hops or drying them?—I think not. It is impossible for any sulphur to get into the hops in any appreciable quantity. I also think that the material we use is so thoroughly pure from any contamination that it is impossible for any damage to accrue from hops. I have heard that arsenic has been found in hops, but I have also known of hundreds of samples being carefully tested by an expert without any trace of arsenic being found. I can only imagine the possibility of any trace of arsenic where a very low class of gas refuse has been used as fuel, and the fumes have left any kind of soot—what I understand as soot, or whatever it may be—in the hops. I can imagine such a case, but the system of hop growing on a large scale is such that I think contamination from arsenic is impossible.

7606. I suppose to use any gas coke would be likely to spoil the aroma of the hops, would it not?—I have no knowledge about that. I have never used gas coke. We have always been able to produce a satisfactory article, one that has given satisfaction to the consumer, by the use of the best anthracite coal. I have adopted that course, and I have never attempted to use gas coke. If coal was at famine prices and coke available we might have used it, but there has never been the necessity.

7607. As far as your knowledge goes even the small growers do not use gas coke, do they?—No. The vessels come in with coal for the large growers, and the merchants who supply us with 100 tons will supply the small growers with one or two tons. The small grower gets exactly the same article as we get. It would not be of any advantage. Even if the smaller growers wanted cheap coal it would not be of any advantage to them.

7608. In your opinion it is unnecessary to take any precautions in the manufacture of hops for the brewer, but you admit yourself that traces of arsenic have been found in hops?—I have heard so, but I do not believe it. When I say I do not believe it, I would not dispute any evidence that has been brought before the Commission, but I think I should have known if it had been conclusively proved that any hops had been found with arsenic in them. For instance, the Hop Trade Association in London do not know of any instance where arsenic has been traced to hops.

7609. It is only lately that it has been looked for?—That is so.

7610. I suppose you would be prepared to say it would be probable that in those cases in which it had been found it might have come from hops that had been sprinkled with powder for the sake of mould?—I do not think that. If it is possible at all it is from using very bad fuel. I do not think it is possible in the growth of the hop, because these heavy, dirty sulphurs could not be got up on to the hops. We only use sulphurs which are absolutely pure—like this sublimated sulphur.

7611. Arsenic is sublimated with sulphur—it is all sublimated together?—Yes, if there is any; I am not a chemist, but what I look upon as the residue would, to my mind, contain the dangerous matter, but it may not be so.

7612. You think that if there is a risk of arsenic it is from the use of improper fuel?—Yes. I think there is no risk in any other way.

Mr. W. W. Berry.

10 May 1901.

Gas coke seldom used to dry hops.

Charcoal used, mixed with coal.

Arsenic in hops.

arsenic in hops

Mr. W. W.
Berry)
10 May 1901.

7613. (*Professor Thorpe*.) Does any quassia get upon the hops?—I do not say it never does, but not often. It is used in the earlier stages.

7614. There is no idea in using quassia that it also adds to the bitterness of the hops, is there?—No. You would not find a good planter wishing to improve the quality of his hops by the addition of anything.

7615. (*Chairman*.) But as a matter of fact, it is very seldom that sulphur is ever used after the burr appears?—Only in very exceptional cases. I have known a case where it has been necessary, but only where the hops have been more or less neglected in the earlier stages.

7616. (*Professor Thorpe*.) Have attempts been made to follow the same methods of using insecticides in hop growing as in grape vine growing?—Only in respect to mildew. I have always thought there was something to be learnt from the vine grower on the question of mildew, because mildew is a most serious trouble to the grower, but the insecticides, I believe, are so different. What we require for our aphids is such a simple remedy and so cheap and easy to be applied, that we do not want to learn from anyone. In the case of sulphur, however, it is different. We have endeavoured to get some information with regard to the methods of applying sulphur. But I do not know any improvement on what we now use—on the finest flowers of sulphur.

7617. In France they largely use what are called the sulpho-carbonates; that is an alkaline solution made by burning together bisulphide of carbon and soda or bisulphide of carbon and lime. It is very soluble, and a very little goes a long way. Has that to your knowledge been used in England?—Yes, I think there are two or three people who are now putting up a compound wash which is used by the smaller growers who do not want to build up the necessary plant for producing the wash such as I use. They buy a cask, or even a gallon of this particular kind of wash, which contains a dissolved sulphur. We know because of the very foul smell when the bung is taken out. It is used to a small extent, but only to a small extent. It may be that we have something to learn in that direction.

7618. Is offal tobacco extract ever used by you as an insecticide?—It would only be used very early in the season, and in very persistent attacks. Nicotine is, of course, one of the best things to use to destroy insect life, but it is very costly as compared with soft soap and quassia. Where you have a plant to manipulate the soft soap and quassia there is nothing so cheap.

7619. I am not speaking of the direct application of nicotine so much as the mere infusion of waste tobacco—what is called offal tobacco, which is cheap enough. The Customs are only too glad if you will take it away?—I have never had it offered to me, or I might have experimented with it. I have no knowledge at the present time of tobacco juice being used in hop gardens at all, but it used to be used.

7620. You are not aware that the Board of Customs gives facilities to agriculturists and people making such things as sheep washes for the use of this product?—I know that every opportunity is given in bond for dealing with this stuff. Chemists have told me that there are some fruit tree washes, and washes which are used under glass, and so on, where it is used, but I do not know of its being used in the hop garden.

7621. The use of a product like that would have the advantage of entirely preventing the possibility of the access of arsenic?—Quite so.

7622. Are foreign hops treated very much in the same way as you have described in the case of English hops?—I have never had time to travel during the hop season. I have had to attend to my own crop, and I, therefore, have absolutely no knowledge on that point.

7623. You have no knowledge of the kind of insecticide which is used in foreign countries in connection with hops?—No.

7624. What I want to get at is whether foreign hops are more liable to contain arsenic than English-grown hops?—I should be glad to hear that they were, but I should not like to say so, because I have no knowledge.

7625. (*Mr. Cosmo Benson*.) Would you tell the Commission how much on an average it costs to cultivate an acre of hops?—£50.

7626. That includes rent, rates, tithe—in fact every-

thing from the commencement up to the completion of the curing of the hops?—£50 an acre. If I get over £50 an acre for the crop there is a profit; if I get less, there is a loss. Some seasons it will cost more, and for this reason: if we grow a large crop that large crop costs a great deal more to pick and cure and get to London than a small crop at a higher price per cwt.

7627. How much of the £50 an acre would you put down to labour: have you ever divided it?—I am afraid I could not give you those figures. If it would be of interest to you I would have them looked up. Labour would be by far the largest item. I should say roughly that £30 out of the £50 would be for labour, probably a little more than that even.

7628. By the time the hop reaches maturity it is more or less an artificial product?—It is unfortunate if it is. It is never so good as when it grows naturally. We have, however, to resort to artificial means to get hops at all in bad seasons. If we did not destroy the insects, the insects would destroy the hops.

7629. I believe you grow several sorts of hops?—We grow Golding hops and Golding hops only. But the Golding hop is in three sections: there is the old Golding which hangs later on the poles than any other varieties, supposing it is healthy, but there is an early Golding hop which is practically the same hop, but it ripens somewhat earlier. That was raised from one plant which was grown in the garden and cultivated on and on. It is called the Brambling Golding, as it originated in the Parish of Brambling. It is the same hop but it ripens earlier. We have an intermediate "sport" now which we call Cobb's variety. I grow no other varieties than those three.

7630. What is the object of growing three different sorts of hops: is it for kiln purposes?—I cannot admit there are three different sorts of hops.

7631. Then three hops that come to maturity at different times?—For this reason. We have to get labour from London and elsewhere, from the large towns, and it would be impossible from a commercial point of view to house all these people for 7 or 8 days only to pick the crop while it is at its best. We desire to pick our hops during three or four weeks, and we get the earlier section of the Golding hop, and the intermediate section, and the later section by careful selection. We have got the best variety of hop now, so that it will ripen in three stages. We can pick them now in about 3 weeks.

7632. (*Dr. Whitelegge*.) Are hops always dried by exposing them to the fumes of the fuel: is there any other method in use?—No.

7633. For what purpose is the sulphur used at this stage?—I am not competent to tell you the reason why, but sulphur, to the extent of about 20 or 25 lbs. to the acre, is scattered over the plants by means of the appliances I have explained, and it has the effect of stimulating a tired plant. For instance, if from atmospheric reasons, from very great heat and drought, a plant is flagging, it, so to speak, breathes the fumes of the sulphur, which is of great assistance to it.

7634. I mean rather the sulphur used in the kilning process—the sulphur that is burnt?—The sulphur that is burnt is, I think, used for the purposes of colour. It is for bleaching purposes. Brewers require bleached sulphur.

7635. Is it used with all hops?—I have known experiments made where hops have been left unsulphured, and I have known the brewers to request that you will send them a few packages of absolutely unsulphured hops; but we have never known the order to be repeated.

7636. Does it alter the hop in any other respect except in colour?—Not the slightest; but when the hop is quite green and begins to dry, the sulphur fumes passing through give the hops the desired colour.

7637. Does that affect the colour of the beer?—I think not.

7638. Is it anything but prejudice on the part of the brewer?—I should imagine it is more or less a prejudice on the part of the consumer.

7639. But if so, it is an universal prejudice?—Yes.

7640. Have you been asked for any guarantee with the hops you supply to brewers?—I understand that brewers have asked for a guarantee from the hop trade. The hop trade is so convinced that there is nothing in the hops, and that it is impossible to get anything wrong in them, that they have declined to listen to any such proposal. Hop trade have refused to guarantee hops as from an

Mr. W. W.
Berry.
10 May 1901.

Tobacco
extract as
insecticide
for hops.

W. W. Berry. 7641. (Professor Thorpe.) Even although they use arsenical coke?—We do not know of any arsenical coke being used. We only use anthracite coal, as far as I know. May 1901.

7642. But you told us that the trade might occasionally use gas coke?—I say if they did there might be a danger, but I can imagine no danger in any other direction.

7643. But there is some danger as there is in the case of malt?—Quite so.

7644. If maltsters are required to give a guarantee, why should not hop growers be required to do so?—Well!

7645. (Dr. Whitelegge.) Would hop growers be prepared to give the same sort of guarantee which has been suggested in the case of maltsters?—I think they would resent it, and say "Why should we give a guarantee, we only use these things?" If you ask me personally my own feeling, I may say that I should be prepared to guarantee my article.

7646. As free from arsenic?—Yes.

7647. You are prepared to guarantee that you use only anthracite coal and Sicilian sulphur?—Yes.

7648. And your sulphur you would be willing to give up if the brewers would consent?—I should be glad to save the expense.

7649. An earlier witness has given us the results of analyses of hops. Bearing upon an answer which you just now gave that it was unknown to the trade that small quantities of arsenic had been found in hops, we have heard from one of the witnesses who has been called before us that a number of analyses of hops have been made in which small quantities of arsenic have been found?—Indeed! I should imagine that the samples could not have come from that part of the country which I have most knowledge of.

7650. What you have told us about the treatment of hops in growth and manufacture applies generally, I suppose, to other districts besides Kent?—Yes, I think so.

7651. You have told us that in Worcestershire it probably is the practice to use coke instead of anthracite?—Excuse me, I do not think I put it in that way. When the question of arsenic was raised I heard of a sample of hops which it was suggested had been dried with gas refuse, small coke. That, I understood, was a Worcestershire sample. But I have no knowledge of coke ever being used anywhere else.

7652. Your impression is that anthracite is principally used, even in Worcestershire?—Yes.

7653. Are there any other important centres except Kent and Worcestershire?—Yes. A good many hops are grown in Hampshire and Sussex, but the process is the same. Except in but a very few cases, I am certain that nothing but the very best anthracite coal is ever used. It is so easily detected if you get any other coal. If other than Welsh coal were used a farmer would know it directly he went into his kiln from the bad smell. A farmer dare not have a bad smell to his hops. If a brewer put his nose to the hops and found there was a bad smell to them he would not buy them. Of necessity we are bound to use the best coal.

7654. I suppose the curing is done on a small scale often; a small grower would cure his own hops?—Yes. There may be a man who has one kiln; in my own case I have thirty kilns, but the process in the one kiln is exactly the same as in my thirty kilns. I think the small grower puts his hops on the market as pure as I do. He buys his coal and sulphur from the same people.

7655. And you think he may be equally trusted to buy only anthracite coal and use pure sulphur?—I think so. He would have a difficulty in getting anything else.

7656. (Chairman.) I do not think you quite appreciate the difficulty. Where would the small grower

buy his sulphur?—He would buy his sulphur one cask at a time where I buy ten tons at a time. Mr. W. W. Berry.

7657. He would probably buy it from a small dealer?—No, I think not. This business is the business of my district, and the sulphur comes down perhaps in 50 or 100 tons at a time to the town. I get my quantity, whatever I want, and the small man gets what he wants. He cannot get anything else. It is kept in stock. What is necessary for large people is necessary for small people, and they have no option. The small people must have the same thing as we have.

7658. Then you think there would be no difficulty in a hop grower obtaining from the sulphur seller sulphur which was pure?—That is my opinion. I have asked all the men I have dealt with if they think the sulphur is pure, and they have told me that they will guarantee that everything shall be pure. They say they believe it is always pure.

7659. But do you think in the future there will be any difficulty in the hop grower obtaining from the firm from which he purchases his sulphur a guarantee of purity?—I have in my hand guarantees from the people from whom I buy, and I have already bought on that guarantee.

7660. What do they guarantee?—I have here a letter from Brandram Brothers and Co., Limited, manufacturers of white lead, and vermilion colour grinders, refiners of saltpetre, brimstone, etc., etc. They write from Rotherhithe, under date of April 15th, 1901, as follows:—"Mr. H. S. Tett, Faversham. Dear Sir,—Enclosed we beg to hand you a supply of circulars, re our sulphur products, guaranteeing same free from arsenic, for distribution amongst your customers. Should the supply be insufficient we shall be happy to send you more. Yours, very truly, Brandram Bros. and Co., Ltd." With that there is a printed notice, which is as follows:—"Notice. To Hop Growers, Chemists, and others. In consequence of the recent trouble caused by the presence of arsenic in beer, Messrs. Brandram Bros. and Co. Limited, of Rotherhithe, London, S.E., beg to state that their 'Brandram's' Pure Sublimated Flowers of Sulphur, 'Brandram's' Finest Virgin Roll Brimstone, 'Brandram's' Finest Hop Sulphur, 'Brandram's' Finest Powdered Sulphur Vivum, have been analysed by the eminent Analytical Chemists, Messrs. E. F. Teschemacher and J. Denham Smith, of 1, Aubert Park, Highbury, N., and pronounced by them to be 'free from arsenic.' That is the notice. The letter says that they guarantee their products all free from arsenic. This is from the principal firm, and I have similar letters from two or three others.

7661. So that in future you think there would be no difficulty for a hop grower getting a guarantee of the purity of the sulphur he uses if he asks for it?—That is so. The fact that that class of sulphur is being sent down to the hop districts would, I believe, make it very difficult for any man to get any other variety than that.

7662. (Dr. Whitelegge.) Would you go so far as to say that it would be wrong to use any other fuel than anthracite and possibly charcoal?—I do not know that it would be wrong, but my successes have been built up by using the very best fuel I can get. I buy the best of everything. The difference between an inferior article and the best is usually only a few shillings. I think £10 a year would make all the difference between buying the best anthracite or the second best. The railway carriage from South Wales is the same. It is only a question of prime cost on the bank, whether it comes out of No. 1 or No. 2 vein.

7663. You do not consider it right to use gas coke?—No, I do not. There is no saving in using it. If the kilns are properly constructed, and the coal is judiciously handled, best anthracite coal is as cheap as coke. The better the quality of the coal the more economical it is.

Hop growers' sulphur is guaranteed free from arsenic.

Anthracite of different qualities.

SIXTEENTH DAY.

WESTMINSTER PALACE HOTEL.

Monday, 13th May, 1901.

PRESENT:

The Right Hon. Lord KELVIN (in the Chair).

SIR WILLIAM CHURCH.
Prof. THORPE.MR. COSMO BONJOR.
Dr. WHITELEGGE.Dr. BUCHANAN, *Secretary*.

Mr. HUGH BAIRD, called; and Examined.

Mr.
H. Baird.
13 May 19017664. (*Chairman.*) You are a large maltster in Scotland?—Yes.

7665. Can you inform the Commission what fuel is used in your maltings?—We use nothing but anthracite coal. We have drawn it from one pit from ten to twelve years, namely, the Gartshore Pit, Stirlingshire.

Anthracite
hand-picked
at collieries

7666. Do you select the fuel in any way, or simply take what comes from the mines?—The fuel that is sent to us has been passed over screens and then through meshes to get it of one size. At the foot of these screens boys and women watch for any piece that they think doubtful. Then when it comes into our possession we have it all riddled before utilising it in any of our furnaces.

and riddled
at maltsters.

7667. A piece looking doubtful in what respect?—Sometimes they may think a piece is not perfectly pure—a dull piece, and then it is thrown to one side.

7668. Those pieces are all rejected by you?—They do not come to us at all. They are rejected at the coal pit.

7669. What length of time is your malt kept on the kiln?—From four and a half to five days.

7670. What steps are taken to prevent accumulation of dust and deposit—the products of combustion?—All our beams and our plates are brushed down once a week, and oftener if required.

7671. And is the floor bared and swept occasionally? Below the kilns it is swept out regularly, sometimes every day, but always twice or three times a week.

7672. That is the bottom of the kiln. But what about the floor on which the malt dries?—That is cleaned every time the kiln is taken off.

7673. Every time the malt is taken off the floor and sides of the kiln are brushed?—The kiln floor is brushed clean, but I referred prior to that to the floor below the kiln, where the dust may come down through the holes on to the bottom floor.

All brewer's
malt brushed.

7674. At what stages of malting, and how often, is your malt screened and brushed?—We clean our malts twice as they leave the kiln before they go into the deposit rooms, and then it is cleaned once, and sometimes twice, over the machinery before it goes to the consumer.

7675. In the case of malt going to breweries would all grades of malt receive the same amount of brushing?—All malts we send to our customers do receive the same amount of brushing.

Pneumatic
malting not
as satisfactory
for brewers as
kiln

7676. Have you had experience of pneumatic malting?—We have.

7677. Do you use it?—We have got one drum, and we work it for distillers' malt, but not for brewers' purposes, because we do not approve of it. We do not think it makes the high-class malt we require to send out to brewers.

7678. In what respect is the malt inferior?—We have found a difficulty in getting it rid of the moisture. We cannot get our malt what we call freed properly.

7679. In the pneumatic malting, is not the air drawn through several cylinders or drums which rotate?—Yes.

Mr.
H. Baird

7680. So as to shake the malt?—The malt falls over gradually.

7681. But you find you cannot get the malt properly dried that way?—We do not dry it in a drum at all. Some people do dry it in a drum, but not in the same drums used to germinate the malt.

7682. In the pneumatic malting the drying would not necessarily take place in drums, though germination does?—I believe some drums are constructed for drying, but I have never seen them.

7683. In "pneumatic malting," as generally understood, then, the drying would be done on the same plan as ordinary kiln drying?—We do so. We dry it the same way in an open kiln.

7684. Why is it that you cannot dry it so well in drums?—We have no experience of drying malt in a drum, and from what I have heard, people do not like it.

In pneu-
malting
drying is
the kiln.

7685. What objection do you understand is made to it?—I do not think malt can be cured unless heat passes through it, and in the pneumatic drying drum you can only pass the heat from the exterior, or through the pipes running through it, and it does not get the same amount of heat applied to it that it would get in an ordinary kiln.

7686. In the pneumatic drying drum the drum is heated, and heated air is drawn through?—Yes.

7687. We have been told there are various processes by which the malt can be kiln dried without being exposed to the fumes of the fire. We have been told that in some of the chief beer factories of Germany the malt in drying is not exposed to the fumes of the fire at all?—There are such kilns in Germany.

German
malt not
posed to
fumes

7688. Have you any experience or knowledge of those kilns?—I have not seen them at work.

7689. That malt makes German beer which is but would be esteemed for some qualities?—Of course, German beer is treated in an entirely different manner to home beer. Beers; the mashing process is quite different, and, therefore, that malt, although it might suit their purposes, would not suit home-brewed beer at all.

7690. Why do you think malt that has been dried without exposure to the fumes of the fire should, if properly dried, not give as good beer?—I see no reason why it should not, if it is properly dried; but it is a question if it is properly dried.

7691. We have been told that part of the flavour that is required by the users of beer in this country depends on the exposure of the malt to the fumes of the coal, and that if the malt was not exposed to the fumes of the coal, it would be impossible to get the flavour that is liked?—You cannot get the flavour if the fumes from the fuel do not go through the malt.

Flavour
fumes
essential

Mr. Baird. 7692. What part of the fumes is it that give the flavour?—I think it is more because on account of the fumes the heat is properly applied to the malt, and gets thoroughly through the malt.

7693. Then, if it were hot air instead of hot fumes, the result, so far as drying, would be thoroughly the same?—It might be, but I question it.

7694. Have you reason to believe that the carbonic oxide or the carbonic acid, or anything else in the fumes is essential to the flavour of the malt?—I should not like to answer that.

7695. Do you see any reason why that malt should not be kiln-dried purely by hot air, supposing the process could be carried out, and produce a malt quite as good as that produced by the present process?—I do not think it could, as far as my judgment goes.

7696. Suppose the hot air gets through it just as much as the fumes of the fire?—There is something that must come from the fuel which gives a flavour to the malt that we cannot get with hot air.

7697. Very different kinds of fuel are used. We have been told by witnesses that in some of the first-class English malt-making oven coke is used. The fumes of oven coke are very different from the fumes of anthracite?—You can get such from pure coke, and also from anthracite. In our high-dried malts we cannot get the same heat from coke to apply to the malt as from anthracite. Especially for stout brewing, we find we get heat from anthracite that gives our malt a flavour, which you might call an oatmeal flavour, which you cannot get otherwise.

7698-99. Have you ever used peat for fuel in your kilns?—Once, and once only, and we had to take the whole kiln down before we could make brewers' malt on it again. We could not get quit of the flavour.

7700. But for distillers' malt it would be suitable?—Yes. It was for a distiller we made it. His works were burnt down, and we did it for him, and the whole kiln was impregnated with peat to such an extent that we could not use it.

7701. The peat fuel is practically used largely for malt for whisky?—Entirely to give whisky the flavour.

7702. Is there any other fuel used for malt for whisky?—Yes, coke.

7703. The greater part of the whisky is made from malt dried by other fuels than peat?—I should say so, the greater part.

7704. Have you made any change in your practice in consequence of the discovery of the liability of malt to arsenic?—No.

7705. Have you had chemical tests made of your malt?—Yes, we have had them regularly made by several chemists.

7706. With what result?—They were found free, except in one case, and that gave us 1-350th of a grain per lb. of malt; the same malt at the same time was tested by three other chemists, who found it perfectly free.

7707. Have you ever had the dust that comes away in the brushing and screening examined?—No, we have not, but our combings that come from the malts were found perfectly free.

7708-9. Do the combings carry with them an outside surface that has been exposed to the fumes of the fire?—Yes.

7710. The combings are chiefly the rootlets?—Yes.

7711. Not the husk?—No husk.

7712-13. Besides the process of screening that takes away the combings, you use brushing to remove incrustation from the outside of the husks?—Yes, we have had brushes in force for about twelve years now.

7714. Have you had any chemical analyses made of the fuel that you used?—We have, and a sample of an anthracite has been declared free from arsenic.

7715. Did you have it done before this scare?—Not before.

7716. Therefore, you have made a little change in your practice in that respect?—We made a change to see if it was pure.

7717. Have you had the malt examined before brushing?—We have not. We have had it always done after it left our screens.

7718. Except in the one case, in which a very small quantity of arsenic was found, no arsenic has been

detected at all in the malts?—No, in none of our malts. I may add that we have them done every week by our own chemist, and by other chemists for arsenic. That is since the scare commenced.

7719. What tests for arsenic have been applied?—I believe the whole of them used the Marsh tests.

7720. Have you been asked to guarantee your malt free from arsenic?—We have, and have done so.

7721. For some time?—For certainly the last five months. I know our malts have been going to brewers' chemists and found all right. I do not know who the chemists were, but they were found perfectly free from arsenic.

7722. The answers to the questions which have been put to you apply to all your maltings?—My answers apply to all the malts we make ourselves. Of course, distillers' malt is not brushed or screened; it goes with the rootlets attached to it. A distiller uses the rootlets along with the malt, except in certain cases, where malts are used for making yeast, and then they have the very best that can be got.

7723. The rootlets contain a fermentable matter?—There is a certain amount of saccharine matter in them, and it can be converted to alcohol, I suppose.

7724. If the rootlets were taken off, would the malt lose some of its value for distillers?—I cannot say.

7725. But in beer the rootlets are never used?—Never.

7726. You send away the rootlets to be used for cattle feeding?—Yes; in fact, all our combings go to the Continent for feeding cattle there. We have had contracts for years for all to go to one port.

7727. What place?—They go to Denmark and Hamburg.

7728. You actually send from Scotland food for cattle to Denmark?—Yes, they buy it from us regularly.

7729. Where is your barley grown?—Nearly all in Scotland, and some in Yorkshire.

7730. You use some foreign barley?—Both foreign and home.

7731. Is the greater part of the barley you use home grown?—The larger proportion.

7732. Does the home supply sometimes fail, and necessitate your taking foreign barley?—We require to make a large quantity of malt from foreign grain for brewers' requirements.

7733. Does the foreign malt fulfil certain requirements that cannot be fulfilled by home-grown malt?—It does. The brewers hold that it brightens the beer more quickly.

7734. May we take the answers you have given as applying on the whole generally to other large maltsters in Scotland?—I think so.

7735. The same system as you follow is practised by the others?—I think so. Everyone has his own system, but I think they are all very particular.

7736. (Sir William Church.) Do the distillers use very much foreign barley?—Some of our distillers use nothing but foreign barley, and others use a large proportion of home. The Highland distillers and the distilleries in the north use nearly all home barley, and they fall back on heavy foreign when they cannot get home; that was owing to the great demand for whisky a few years ago, and the great quantity of whisky distilled.

7737. You mean by the northern whiskey makers the people about Inverness, for instance?—And on the West coast, too.

7738. They use chiefly home-grown barley?—Yes.

7739. That barley must be less well harvested than the barleys of the Southern counties?—Certainly it is; but in some cases some of our northern districts in Scotland grow as fine barley as I ever saw anywhere—Cromarty, Ross-shire, and Inverness.

7740. But they are more liable to have it injured in the harvest?—It depends entirely on the weather. We have seen barley grown in the finest counties in England ruined by getting rain before we got it. Our barleys were not so ripe, and could stand up against the weather, whereas English barleys being riper would give way.

7741. You told us that the distillers, who want, of course, a very high percentage of alcohol, use home

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Guarantees his malt free from arsenic.

Distillers' malt usually not screened or brushed.

Malt culms exported as cattle food.

Foreign barley largely malted for brewers.

and for distillers.

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especially
raw grain
distillers.

malt to a very great extent. We have been told that you want the foreign malt because weight for weight it contains more fermentable matter than the home malt, and less nitrogenous matter?—The northern distillers and the west coast distillers make malt whisky. The southern distillers are raw-grain distillers, and they not only use a large quantity of Indian corn converted, and they malt this light foreign barley to assist them with their converted maize. There are two distinct distillers, the grain distiller and the malt distiller.

7742. I do not know whether you could answer this question for me. I suppose that the presence of nitrogenous matter in the malt in undue proportions is not so important for the distiller, who distils his product, as for the brewer who does not?—That I could not say.

7743. (Dr. Whitelegge.) In one sample, and one only, arsenic was found in a very small proportion—1.350th you say?—Yes.

7744. Was that brushed?—Yes. It was ordinary screened malt that went from one of our malthouses. It was screened and brushed.

7745. Do you make more than one class of malt?—We do.

7746. Several classes?—Yes.

7747. Is brushing applied equally to all?—All our pale malts are brushed and screened, and have been so for fully twelve years.

7748. How long has it been the practice to pick over the fuel in the way you describe to us?—Our man has told us it has gone on ever since we got it from him.

7749. Do you stipulate for that?—Yes; we made a stipulation for nothing but pure anthracite coal, and it has to be picked over.

7750. (Chairman.) Can you give the Commission the form of guarantee that you use?—As far as my memory goes we guarantee our malts pure.

Form of
guarantee
of malt
given.

7751. (Mr. Cosmo Bonsor.) Perhaps you will send it in?—I will send a copy with pleasure; it is a stamped form. "Our malts are free from all foreign or poisonous matter." We stamp our invoices with this when requested for a guarantee.

7752. (Chairman.) That is your guarantee?—Yes.

No guarantee
with fuel.

7753. And the condition that you exact in respect to the coal, to have it hand-picked by the people at the pit mouth; have you that form?—We have not that in writing; we simply insist on nothing but pure anthracite coal being given to us. I should just like to say, of course, that we use coal in our kilns, but we use to a large extent coke in our retorts. We are large makers of black malt. Of course these are hermetically tight.

7754. The black malt is not exposed to the fumes at all?—No.

Black malt
not specially
exposed to
fumes.

7755. The black malt is made from grain first malted in your kilns?—It is first dried at our kilns, and then converted into black malt in the cylinders or the retorts.

Mr. ROBERT GRANT HOOPER, called; and Examined.

Mr. E. G.
Hooper.

7772-5. (Chairman.) You are a Fellow of the Institute of Chemistry, Fellow of the Chemical Society, and a Member of Council of the Society of Chemical Industry?—Yes.

7776. You have been an analyst for 24 years in the Government Laboratory?—That is so.

Samples of
arsenical
beer, on
which rebate
claimed,
tested at
Government
Laboratory.

7777. What have you to say with regard to experience of the Government Laboratory in the question of the presence of arsenic in beer?—The question of the presence of arsenic in beer and brewing materials first presented itself officially at the Government Laboratory at the beginning of December last, when, in consequence of the discovery of arsenic in certain beers brewed in Lancashire, applications were made to the Board of Inland Revenue to permit the destruction of the contaminated liquor in the presence of Excise officials, with a view to the repayment of the duty which had been charged upon it. Samples of such beers were then forwarded to the Government Laboratory, and continued to be received for some time. In all 748 samples have been lodged, representing 28,264 barrels, the produce of 67 brewers scattered throughout 11 counties, but mainly in Lancashire, Staffordshire, and

7756. But so far as the kilning is concerned there is no distinction?—No.

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7757. And then you put it afterwards into the cylinder, like a coffee roaster?—Yes.

7758. In these cylinders you use whatever fuel you like?—What we can get the greatest heat from. We have not the same draught, and therefore we cannot use anthracite coal with it.

7759. (Mr. Cosmo Bonsor.) Do you kiln-dry your barley?—All our home barleys.

Kiln-dry
of barley

7760. That is kiln-dried with anthracite, and not coke?—With anthracite, and not coke.

7761. (Chairman.) In that first drying, the heat is much less than in a final kiln drying?—A great deal less.

7762-65. (Dr. Whitelegge.) Do you know anything of any method or suggestion of treating fuel with lime, or other base in such a way as to prevent it giving off arsenic?—I never heard of it.

7766. (Chairman.) I wish we could really get information of a positive kind, whether or not the exposure of the grain to the actual fumes of the fire is required to get the proper flavour. We have asked many gentlemen who know their own business well, and know the business generally, and we have got no decided answer, but merely the answer that there is a general opinion or idea that the hot air which kiln-dries the malt ought to come from the fire, if the beer is to have the desired flavour, but we have no experimental proof of that opinion at all. We had one interesting statement to the effect that in a certain particular case of kiln drying, the malt was not exposed to the fumes of the fire, and it was very good. Have you information of that kind?—There has been only one kiln recently erected in Scotland to dry malt without a direct fire, and that has been erected to make lager beer, because when they put it on the other kilns they found they wanted not to dry it so highly. I do not know the result of that.

Flavour
of fumes
thought
be essen

7767. But that makes lager beer?—Yes; I question whether the malt would make Scotch beer. But I have not heard the results.

7768. There does not seem any good reason to expect that if the malt was dried with hot air at the same temperature, and to the same amount of dryness, without the fumes having come from the fire itself, the result would not be as good?—I do not think it would be as good.

7769. (Mr. Cosmo Bonsor.) Could you sell it?—I question whether I could.

7770. (Chairman.) You have never made the experiment?—I have been asked by a distiller to make malts for him when he got into trouble.

7771. (Professor Thorpe.) Is not the distinction rather of the same order as that which obtains between meat roasted at the fire and meat roasted in the oven; there is a belief on the part of some people that meat roasted in the oven has not the same flavour as when roasted before the open fire?—So I understood.

Yorkshire. It cannot, however, be asserted that this comprises the produce of every brewer who may have used arsenicated materials, as some are known to have destroyed their beer immediately they became aware that it was contaminated, and without lodging applications for the repayment of duty. An examination of the brewers' entries of the materials used in the particular brewings, together with a determination of the exact original gravity, and a qualitative examination of the beer for arsenic, would have sufficed to substantiate the claim for drawback, but with a view of affording information to the Royal Commission, it was decided to make a more detailed examination in order to obtain some precise knowledge as to the extent to which the beer had been contaminated. The accurate estimation of the amount of arsenic in so large a number of samples would, of course, have occupied a very considerable amount of time, and it seemed unnecessary to do more than to make a selection from the produce of each brewer. In all 143 quantitative determinations of the arsenic in these beers have been made, and full particulars with reference to the origin of the samples, the dates of brewing, and the proportions of arsenic found are given in Table I., from which it may be

Mr. E.
Hooper

Quantitative
determinations

seen that the results are fairly representative of the whole. There is no reason to suppose that any further information as to the order of amount in which arsenic was present in the contaminated beers would have been obtained if the entire number had been quantitatively examined. It may be stated that in the Government Laboratory the estimation of minimal amounts of arsenic in metals, such as zinc, copper, and tin supplied by contractors to the Post Office, India Office, etc., is of constant occurrence, and considerable attention has been given for some years past to the subject of its accurate quantitative determination. It appeared possible that the process employed in such cases might be so adapted as to permit of the separation of small quantities of arsenic from beer and brewing materials—that is, from solutions containing a relatively large amount of organic matter, and experiments were made, to begin with, to ascertain how far the associated organic matter interfered with the accurate estimation of arsenic by the well-tried methods hitherto used. Known quantities of arsenious acid were added to wort and beer, and after concentration, the arsenic was precipitated with sulphuretted hydrogen. The sulphide of arsenic, with a varying amount of organic matter which falls out of solution in the course of the treatment, was then filtered off, and afterwards distilled with ferric chloride and hydrochloric acid. Under these circumstances the arsenic distills as arsenious chloride, accompanied only by a small amount of organic matter, from which it can be readily freed, and the arsenic is finally precipitated and weighed as arsenious sulphide.

7778. You say "a small amount of organic matter from which it can be readily freed." Will you describe to the Commission how it is freed from organic matter?—The precipitate of sulphide and of organic matter is collected on a filter paper, the filter paper is rolled up with its contents, and transferred to a small flask, where an addition of hydrochloric acid and ferric chloride is made, and, on heating, the arsenious chloride distills off, carrying over at first a trace of organic products, but only a trace. The distillate contains the whole of the arsenic. It may be necessary to redistil it to free it from the traces of organic matter carried over, but after such distillation the sulphide is precipitated with sulphuretted hydrogen, and is weighed on a Gooch capsule on a layer of asbestos. The apparatus is in the next room if the Commissioners would like to see it.

7779. You said that the distillate carries away the whole of the arsenic. Have you tested the residue to see whether or not there is some arsenic in it?—Yes; after the first distillation a second distillation is taken, and the distillate collected apart. Sulphuretted hydrogen is passed through that second distillate to see there is no arsenic. Should there be arsenic a third distillation is taken, and so on, until a distillate is obtained which contains no arsenic.

7780. But, as a rule, is all the arsenic carried off in the first distillation?—Where the quantity is small, as in any of these beers, it is so. Where the quantity is large, as in some of the experiments we have made, amounting up to 19 or 20 milligrammes instead of 2 or 3, then a third or fourth, and in some cases where the organic matter has been considerable, as where we have taken a large volume of wort to operate upon, the five or even six distillations were necessary to get over the last trace of arsenic. (The apparatus was exhibited, and explained to the Commission.) The beer having been concentrated from a litre down to about 150 cc., is acidified by the addition of hydrochloric acid; sulphuretted hydrogen gas is passed through it, and we then get the arsenic precipitated with a certain amount of organic matter. After standing for some hours it is filtered, generally the next morning, on a plate filter just covered with a filter paper, and the amount of matter which separates is of this character. This includes the arsenic and the organic matter. It is rolled up with its contents and transferred to this small flask, where hydrochloric acid and the ferric chloride solution are added, and the distillation is then commenced.

7781. The paper disappears?—It becomes more or less charred and disintegrated. The connections are all ground so as to fit tightly and no cork or rubber is in any way in contact with the hydrochloric acid which distills over, carrying with it the arsenic chloride. It meets nothing but glass on its way; the whole of the arsenic chloride is retained in the first receiver, but by way of precaution, lest any trace should escape condensation, a side delivery tube passes any vapour through a U tube containing a small quantity of water. This dis-

tillate contains the whole of the arsenic. Sulphuretted hydrogen is then passed through the solution, with the result that the arsenic is precipitated there, not quite of pure colour. This is separated and redistilled, with the result that a pure distillate of arsenious chloride is obtained, which is once more precipitated by sulphuretted hydrogen, and the pure arsenious sulphide is then filtered on to a small perforated Gooch capsule coated with a little asbestos.

7782. How is this asbestos prepared?—It is treated with hydrochloric acid washed and heated to redness.

7783. This looks like a piece of fabric?—Yes, the finely divided asbestos fibres settle in a felt-like layer.

7784. It simply results from the asbestos being allowed to settle?—Yes.

7784*. (Professor Thorpe.) It has not merely settled but been pulled into a tight mass by the force of the pump?—Yes.

7785. (Chairman.) How is the asbestos got into that finely subdivided condition originally?—A special preparation of asbestos is sold for the purpose, but we go through it carefully, and see it is finely divided; it is shaken up with water, and a little of the water is poured on, leaving the layer of asbestos.

7786. This makes a very thorough filter?—Yes.

7787. And allows nothing of the precipitate to go through?—None whatever.

7788. Is it as thorough a filter as the best blotting-paper filter?—Yes; it is better in many respects than even the finest papers we have.

7789. As thorough in its prevention of anything going through?—That is so. It has also the advantage afterwards that, unlike paper, after being dried it is not hygroscopic; it does not take up moisture, so that you can weigh it without any danger of its increasing in weight from the absorption of water from the atmosphere.

7790. Gooch's filter, including the small Gooch capsule, and the use of the asbestos you have described, is a well-known process?—Yes.

7791. What have you to say about the validity of this method?—The validity of this method of determining the amount of arsenic in beer and brewing materials was established by the following experiments, viz.:—(1) Malt worts produced in the laboratory were examined by the process, and proved to yield no arsenic. (2) To malt wort proved to be free from arsenic, known quantities of arsenious oxide were added, and the arsenic then separated and determined. Thus: Arsenious oxide added 0.5 milligrammes, quantity found 0.56 milligrammes; arsenious oxide added 1.9 milligrammes, quantity found 2.1 milligrammes; arsenious oxide added 4.8 milligrammes, quantity found 4.9 milligrammes; arsenious oxide added 19.2 milligrammes, quantity found 18.8 milligrammes.

7792. Added to how much wort?—To either a litre, or half a litre of malt wort. To prove that beer might be concentrated directly, i.e., in the slightly acid condition, without loss of arsenic, the following experiment was made. Arsenicated beer from a brewery was divided into two portions of 900 c.c.s. each. One portion was directly evaporated, and the other was first rendered just alkaline by the addition of pure caustic soda, and then evaporated. The two experiments were otherwise conducted alike, and the arsenic estimated by the process already described. The results in the two cases were 0.21 and 0.20 grain of arsenious oxide per gallon of beer. As regards minimal quantities, it may be pointed out that quantities of arsenious sulphide not exceeding two-tenths of a milligramme are readily isolated and weighed. Two-tenths of a milligram of arsenious sulphide calculated on a litre of beer equals 0.011 grain per gallon, or one part in more than six millions, and the same weight calculated on 100 grammes of sugar or of malt equals 0.011 grain per lb., whilst one litre of beer or 100 grammes of brewing sugar or of malt does not represent the maximum quantity that it is possible to employ for analysis when using this method. Further experiments are described later in connection with the study of the influence of fermentation. For the determination of arsenic in brewing sugars a weight of 50 or 100 grammes of the sugar is dissolved in 150 c.c.s. of water, acidified with hydrochloric acid and the arsenic precipitated with sulphuretted hydrogen, and ultimately separated and weighed in exactly the same manner as in the case of beer. In the case of malt the same process is used, the arsenic

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The method tested with malt worts made in the laboratory.

Similar method of testing malt.

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being removed from the malt, where unground, by heating two or three times with hot water, containing a little pure alkali, and where ground, by first mashing and then thoroughly washing the grains. The washings, or the combined wort and washings, as the case may be, are then concentrated, and treated for the separation of the arsenic by the process adopted for beer.

7793. (Chairman.) Would the alkali suffice to take the arsenic out of any grain when not ground?—There would be no difficulty whatever in taking the arsenic out.

7793a. Would it not take a long soaking before the arsenic would come out?—No. Boiling water dissolves 11 per cent. of arsenious acid, consequently the very small quantity of arsenious acid present on the malt would be readily dissolved.

7794. If on the outside of the malt?—It always is if it is unground.

7795. But if there was any arsenic inside it would not come out so readily?—No, it would be necessary to practically turn the malt into wort.

Question of
combination
of arsenic
with organic
matter of
beer.

7796. What have you to say as to the influence of fermentative action on arsenious or arsenic oxide present in wort, with special reference to the possibility of the formation of so-called organo-arsenic derivatives and consequent failure to detect the arsenic in such compounds?—It was considered advisable that a fermentation experiment should be made on a scale sufficiently large to afford clear evidence of any formation of organo-arsenic compounds from which arsenic would fail to be separated by the process described. With a view of imitating, as far as laboratory appliances would permit, the conditions obtaining in practice, it was decided to operate upon a relatively large volume of wort containing from two to three grains of arsenious oxide per gallon. In such a case the quantities of liquid and of arsenic might be anticipated to afford an unequivocal result, and if any loss occurred in consequence of the increased difficulty of separating the last trace of arsenic from the considerable amount of organic matter accompanying the sulphide, as first precipitated and necessarily distilled with it, this would tend, not to obscure, but to increase the weight of evidence of the formation of such organo-arsenic compounds. A quantity of wort of 1060° gravity was accordingly prepared and divided into three parts. To one part (a litre) yeast was added in equal quantity to that used in the two succeeding experiments, portions of the same bulk of yeast being used in each of these cases. When fermentation was complete the liquid was concentrated without separating the yeast and the whole tested for arsenic. No arsenious sulphide was obtained, and the freedom from arsenic of both wort and yeast was thus established. To five litres of the wort 193.7 milligrammes of arsenious oxide was added and then yeast as before. Fermentation was allowed to proceed until the specific gravity of the resulting beer had been reduced to 1016°, and the whole bulk, including the yeast, was then concentrated and the arsenic determined as in previous instances. The amount of matter first separated was, of course, large, and several distillations were necessary before a distillate was obtained which contained no arsenic. Finally the pure arsenious sulphide, as weighed, equalled 190.3 milligrammes of arsenious oxide against 193.7 milligrammes added. Thus 98.2 per cent. of the arsenic present was recovered under these conditions, or, in other words, instead of 2.71 grains per gallon known to be present, 2.65 grains were actually found, and if any organo-compound of arsenic was formed, the extent to which it eluded detection amounted to no more than 0.06 grain of arsenious oxide per gallon. As a measure of the action exerted by yeast in removing arsenic from arsenicated wort the following experiment was next made. To a third portion of the wort previously tested, arsenious oxide was added to the extent of 2.51 grains per gallon. It was then fermented by the addition of the yeast already proved to be free from arsenic, and when fermentation was complete and the bulk of the yeast had deposited, the wort was syphoned off and cleared by the addition of finings. When the finings had settled, five litres of the clear beer were separated, and in this quantity the arsenic was determined as before. The arsenic found amounted to 171.9 milligrammes, against 179.8 milligrammes of arsenious oxide known to be present, correction being made for the alteration in volume due to the addition of finings. There was thus a recovery of 95.6 per cent., and diminution of arsenical contamination by the removal of the yeast formed during fermentation in this particular

No alteration
in recover-
able arsenic
results from
fermentation

case therefore did not exceed 4.4 per cent. even in a strongly contaminated beer. Expressed in grains of arsenious oxide per gallon the reduction was from 2.51 to 2.40 as an extreme result, for this determination again was made on the large quantity of five litres. It remains to be determined how far hops (with or without associated sulphur) may influence the removal of arsenic by the formation of arsenious sulphide, which may be removed either by straining through the hops in the hop-back, or by subsequent deposition on the surface of the yeast. To prove that arsenic oxide if present would be isolated by this process as readily as arsenious oxide, and that fermentation in this case also in no way interfered with the ultimate determination of the whole of the arsenic present, two further experiments were made. Known weights of arsenic oxide were fully oxidised by boiling with bromine-water, and after the excess of bromine had been boiled off, the solutions were added to wort, and the latter fermented. When fermentation had ceased, the resulting beers were concentrated, and the arsenic present in each case was determined as in the previous experiments. The results were as follows, viz. :—

EXPERIMENT I.

	Milligrammes.	milligrammes.
Arsenic equal to arsenious oxide	added 3.45	found 3.45

EXPERIMENT II.

	"	"
Arsenic equal to arsenious oxide	0.7	0.8

A control experiment was carried out in this case whether also, and the wort and yeast used proved to be free from arsenic. It will be seen that these fermentation experiments afford little or no evidence of the formation of organo-arsenic compounds, but, on the contrary, indicate that there is either no production of compounds from which arsenic cannot be separated by the ordinary tests, or that, at the outside, such compounds are only formed to an extent that for practical purposes is quite negligible.

7796a. (Chairman.) I see you say "known weights of arsenious oxide were fully oxidised by boiling with bromine water?—Arsenious acid on being heated with an oxidising agent, such as bromine, becomes converted into arsenic acid. Arsenic acid is not immediately precipitated by sulphuretted hydrogen. In other words, it has to be reduced to the arsenious condition before sulphuretted hydrogen acts upon it with the production of arsenious sulphide. Therefore it might be contended that if arsenic acid were present in any of these brewing sugars and went through the brewing process unchanged, the process of precipitating that arsenic by means of sulphuretted hydrogen would fail so far as arsenic acid was present. We have proved, whether arsenic acid or arsenious acid be present, both are separated and determined by this process.

7797. (Chairman.) What was the composition of the wort used for fermentation in the experiment?—It was entirely malt wort.

7798. No glucose?—No glucose was added.

7799. Before it was fermented was it boiled as would be done in actual brewing with hops?—Yes, it was boiled, but no hops were used that the question might not be complicated by any action the hops might have on this particular experiment.

7800. In the experiment in which the yeast was separated, was the arsenic in the yeast estimated?—It was not.

7801. Have you any evidence as to the form in which the arsenic is present in the yeast?—None.

7802. In these experiments have bi-sulphites or other preservatives been added?—No preservatives were added.

7803. Nor phosphates?—No.

7804. Nor yeast foods?—No.

(Professor Thorpe.) Have you any reason to believe that any of these things would modify the results?—No.

7805. Assuming that the wort has been made partially with a saccharine solution such as glucose or invert, is there any reason to believe that the results would be in any way modified?—I think not.

7806. (Sir William Church.) When you added compounds of arsenic such as cacodylic acid or any of its salts, you would not recover them by this method?—

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E. G. Express experiments have not been made with cacodylic compounds, but it has been proved here that no cacodylic compound is formed naturally in malt wort, or if any such compound is formed, it is actually operated on by the sulphuretted hydrogen and is obtained in this process. There is no evidence, however, of the formation of any such compounds in an ordinary fermentation.

7807. That I follow and understand, but supposing that it were present, this process would not discover it, would it?—It is stated that cacodylic acid is not precipitated by sulphuretted hydrogen. If sulphur compounds are formed they appear to be either soluble in or decomposed by hydrochloric acid.

7808. But you have not performed any direct experiments for that purpose?—No.

7809. You have kindly shown the Commission all the steps of this process, which is very complete, but at the same time it does not seem to me to be a very laborious chemical process? It is simple enough?—That is so.

7810. I was going to ask whether in your opinion such a test as that could be satisfactorily worked by any competent analytical chemist?—Quite so. There is no difficulty at all about it. Every piece of chemical work demands care and accuracy. There is nothing involved about this; it requires just the usual care and accuracy which any good piece of chemical work demands.

7810a. (Chairman.) It is very much more laborious or longer than the Marsh test?—Yes. Naturally it takes a considerably longer time. This is a quantitative determination instead of a mere qualitative test.

7811. This determination would require at least two days?—No. If you are doing a number two would be finished every day. Two would be started to-day and completed to-morrow, when two further experiments would be started so that the output would be two a day.

7811. One experiment could not be completed in less than two days?—Not on the lines we have taken.

7813. The Marsh test is much more speedy?—Yes, but it is not a gravimetric test.

7814. The Marsh test still continues to be very valuable for many purposes, but in your view is not a quantitative test?—Most valuable. Of course it is used as a quantitative test as well.

(Sir William Church.) You can get evidence of the presence of arsenic by this test when you do not get sufficient precipitate to be weighable?—Yes. If you will take the smaller of the Gooch's, you will see there is a slight yellow stain on one. We have had several illustrations where that has weighed less than 1-10th of a milligramme. We have had evidence of a smaller quantity than one could actually weigh. But I think we would generally stop at a point where we could weigh.

7815. (Chairman.) In that case what was the result obtained from?—A litre.

7816. Could the Reinsch test have given any indication whatever of arsenic in that case, the exceedingly small quantity?—I should be very doubtful about it myself, but my experience of the Reinsch test is not so considerable as that of many others.

7817. Would the Marsh test have shown anything in this small case?—It would.

7818. So that the Marsh test would show something, when the Reinsch test shows nothing?—I think so.

7819. The quantity used in the Marsh test need be very small to show it?—The common quantity used is 10 cc., but I have not found it advisable to limit it to that small quantity myself. I prefer to use up to 50 c.c.

7820. Even that is only 1-20th part of the amount used in the quantitative test you have described?—That is so.

7821. Could either the Marsh or the Reinsch test be rendered sensitive for the exceedingly small quantity you speak of by applying them to a much larger quantity of liquor than 50 cc.?—Yes, I think they could.

7822. Even without concentrating the liquor?—No; I should proceed in that direction, I think.

7822a. (Professor Thorpe.) There is a practical difficulty in the employment of any concentrated solution by the Marsh test?—Yes, due to the frothing.

7823. When you take these highly sweetened and concentrated solutions they froth in the apparatus to an inconvenient extent, and therefore the whole froth is carried bodily forward in the gas and soils the tube?—Yes, there are limitations in the Marsh test.

7824. (Chairman.) You need to get quit of the thick gummy matters?—Certainly.

7825. Does that apply also to the Reinsch test?—Yes; as concentration proceeds in the Reinsch it is very liable to bump considerably; we have had the liquid thrown right up to the ceiling in the laboratory you were in this morning.

7826. (Dr. Whitelegge.) Nothing is done with the filtrate after the first precipitation with sulphuretted hydrogen, is it?—We always keep it over, and it has repeatedly been further examined. The gas has been again passed through it, and if any precipitate whatever falls—because organic matter will fall on standing—it has been again filtered and the precipitate distilled. But we have not found any arsenic so retained, proving that the whole is taken out at the first precipitate. But that has always stood in our quantitative experiments all night.

7827. Have you seen the evidence that Dr. Campbell Brown gave us the other day?—I saw the newspaper report.

7828. He told us that taking, not an experimental beer, but what we may call a Bostock beer in acid solution, sulphuretted hydrogen gave a precipitate?—Yes.

7829. Passing sulphuretted hydrogen through the filtrate he sometimes got a second precipitate, but passing a second, third, and fourth time gave no further precipitate. Nevertheless, on oxidising the organic matter present in the filtrate he obtained a residuum of arsenic?—I think there are some practical difficulties to meet which experience with the process is necessary. Probably Dr. Campbell Brown did not get so far. I consider it very essential that a clear filtrate should be obtained. Dr. Campbell Brown, I gather, did not succeed in getting that clear filtrate. A clear filtrate cannot be obtained readily if the solution is filtered cold, even with the use of the best paper. But if heated nearly to the boiling point, and then filtered, an absolutely bright filtrate is readily obtained. Under those circumstances there can be no danger of any arsenious sulphide failing to be obtained on the paper. I have alluded to it as being absolutely essential that a clear filtrate should be obtained.

7830. (Chairman.) Have you tested the clear filtrate for arsenic?—Yes, on several occasions, and we have never found any carried through.

7831. The first filter is an ordinary paper filter?—Yes.

7832. And you found no arsenic has come through that?—That is so.

7833. (Dr. Whitelegge.) Have you tested the filtrate by Marsh and otherwise than by sulphuretted hydrogen?—No, I have not done that.

7834. You have not adopted the particular procedure of oxidising the organic matter?—No, that would be too lengthy. The essence and advantage of this process is that it avoids the necessity for that.

7835. The suggestion I understand him to make is not so much that there is arsenious sulphide there that has not been collected but that the arsenic has not gone down?—Quite so. But our experimental evidence proves that there is no such compound as that. Arsenic is put into wort, and the latter fermented. The arsenic is then separated and found to be equal in amount to that added, thereby showing there has been no such combination of arsenious acid with organic matter as precludes the precipitation of arsenic under those circumstances.

7836. Do you think it is safe to assume any arsenic present will come down as a sulphide?—The experimental evidence establishes that.

7837. But is that entirely in accord with what Dr. Campbell Brown found, dealing with a beer made from arsenicated materials?—143 determinations have been made on Bostock's beers, and the quantities obtained show that there could be no loss because the quantities are larger than a number of other people have found.

7838. In some cases, but in other cases your method has given a smaller quantity, has not it?—You mean in a reference case?

7838a. Yes?—But the results obtained in the Govern-

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ment laboratory were supported and confirmed by other evidence. I could give you the particulars if you wish them.

7839. (Sir William Church.) Your result is the result of actual weighing?—That is so.

7839a. The others were only the results of estimation?—In some cases, Dr. Campbell Brown does weigh his, but he goes through the process of destroying the whole of the organic matter.

7840. (Chairman.) Dr. Campbell Brown gave very distinct evidence to the effect that he found in the first place a precipitate by sulphuretted hydrogen; in the second place a little more precipitate. A third, fourth, and fifth gave no more arsenic. Then he oxidised, by chlorates I think, and got a residue from which he obtained rather more arsenic than he had got out in the first, second, and third put together; that is substantially his evidence, and he gave it in the most circumstantial manner. Can you suggest any explanation of that?—There are several points upon which the accuracy of his results would depend. First of all the solution must be completely saturated with sulphuretted hydrogen or the whole of the arsenic would not be precipitated, and on each fresh treatment he would get down a further precipitate with sulphuretted hydrogen. But I am inclined to think from my own experience that the explanation of his results—that is, those results of getting successive quantities, is due to an inefficient filtration. There is the extreme difficulty in obtaining a clear filtrate from a beer of this kind unless it is specially treated. I found it so myself, but it is quite possible that with efficient filtration you can get out the whole of the arsenic present. Sulphur must, of course, be first formed. If you pass sulphuretted hydrogen for only a limited time you may precipitate half the arsenic, but if you pass it long enough the whole of the arsenic is thrown down. I should not imagine Dr. Campbell Brown would pass sulphuretted hydrogen gas through his solution for a limited time, and therefore that is probably not the explanation.

7840a. (Dr. Whitelegge.) He says: "One litre of the beer is concentrated, is acidulated, and precipitated by sulphuretted hydrogen, the gas being passed until the laboratory is closed for the day," and that is repeated twice or three times and four times?—That is without any previous oxidation.

7841. This was an experiment to show that oxidation is necessary. After having removed as much as can be removed by the treatment with sulphuretted hydrogen and separation of the deposit, there remained in solution a very material amount, equal to that removed by the sulphuretted hydrogen?—Our experience is exactly the contrary to that.

7841a. That I gather, and I want to know if you can throw any light on it?—I think it is due to the filtration. He said in the notes I saw of his evidence that he failed to obtain a clear filtrate.

7842. He told us also that the discrepancy did not arise where arsenious oxide had been added to finished beer; it was only in beer brewed from arsenicated materials that he found this difficulty in getting down a very large proportion of the arsenic?—The only difference is that there had been a fermentation in between. We have made experiments on that basis, and we found no difference under such circumstances.

7843. Your artificial brewing gave results in accordance with the experiment with directly adding arsenic?—Quite so.

7844. Dr. Campbell Brown's experiments did not?—No.

7845. (Professor Thorpe.) Is there any *a priori* reason to believe that by brewing the arsenious oxide would change?—None that I am aware of.

7846. (Dr. Whitelegge.) In speaking of yeast you say: "There was thus a recovery of 95.6 per cent. and diminution of arsenical contamination by the removal of the yeast formed during fermentation in this particular case did not exceed 4.4 per cent. even in strongly contaminated beer." Would not the quantity of arsenic thus removed, if expressed as a percentage of total arsenic, be likely to be less marked in a strongly contaminated beer?—Not where the arsenic was not present to such an extent as to inhibit the growth of the yeast. Two grains to the gallon would not inhibit the growth of the yeast, so that for all practical purposes there was a normal fermentation.

7847. I was looking at it in the other way. Yeast is able to take up a small amount of arsenic. Would not

the amount of arsenic that the yeast could take away be relatively larger if the initial amount of arsenic is small?—No, I should imagine that since it had plenty of food on which to feed it would avail itself to the full and take out the larger quantity.

7848. (Professor Thorpe.) That is on the supposition that arsenic is a yeast food at all?—Exactly.

7849. (Dr. Whitelegge.) Supposing we were experimenting with yeast upon two worts, one largely arsenical and the other arsenical to a slight degree, the amount of yeast being the same in each case. If the yeast abstracted the same amount of arsenic from each wort, then the percentage of arsenic taken up by the yeast would be higher in the case of the slightly arsenical wort?—Yes, supposing it is constant throughout it would.

7850. (Professor Thorpe.) Is there any evidence to show that yeast takes up a constant amount of arsenic?—No.

7851. (Dr. Whitelegge.) You say that it did not exceed 4.4 per cent. even in the strongly contaminated beer. I should have thought the suggestion was the other way round?—I do not think so. I quite think it would take up more rather than less, the more the arsenic is present.

7852. (Sir William Church.) The stronger the contaminated beer the more chance there would be of some possible compound of arsenic being entangled in it?—Quite so. All the sediment goes down with the yeast. Not merely all the yeast has gone down, but whatever matter has fallen out of the solution in the process of brewing together with the finings has been carried down, and whatever could possibly be entangled has amounted only to this percentage. I do not contend that yeast has taken up any.

7853. (Professor Thorpe.) I should like at this stage to make clear what has been said with reference to the imputation which I gather was made by Dr. Campbell Brown that the Government Laboratory was in the habit of finding less arsenic than several analysts in police cases which had been before magistrates. That is not the case, and I should like to make that clear. Here is a paper which contains the whole of the police cases with which the Government Laboratory has been concerned, and although Mr. Hooper was not concerned in the actual cases—

7854. (Sir William Church.) My impression is that we had evidence before us that Dr. Campbell Brown and the Government Laboratory agreed in one case and differed somewhat in another.

7855. (Professor Thorpe.) That is not as I read it in the evidence. All my knowledge of what Dr. Campbell Brown said is what Dr. Whitelegge elicited from him. Dr. Whitelegge asked Dr. Campbell Brown whether there was not a certain case in which he found a relatively large quantity of arsenious oxide, in which he was corroborated by Dr. Stevenson, and in which the Government Laboratory found only a small proportion—I think 1-100th of a grain. There was a certain case which was tried at Rochdale in which the Government Laboratory found 1-30th of a grain, and in which they were independently corroborated by two other analysts. That was a beer which was brewed from malt and hops, and was proved by our own Excise officer as well as the brewer himself to be so brewed.

7856. (Chairman.) Was that a case in which Dr. Campbell Brown found as much as 1-5th of a grain of arsenic?

(Professor Thorpe.) That was a case in which he said he found as much as 1-5th of a grain. Then there was another case which was mentioned by Mr. Jones of Wolverhampton. Mr. Jones, of Wolverhampton, who described his process, which, you will remember, consisted in a modification of the Reinsch's method, in which the arsenic was removed from the beer by copper, and afterwards dissolved off the copper and distilled with ferric chloride and hydrochloric acid—in that particular sample of beer Mr. Jones found .07 grain of arsenious oxide per gallon. We found in precisely the same sample of beer .19, which is getting on for three times the amount of arsenious oxide which Mr. Jones obtained. On another occasion he found in a certain sample of beer as little as .09. In that particular case we found as much as .38, that is to say, four times as much. That I put down to the fact that the copper in Mr. Jones's process does not really abstract the whole of the arsenic from the solution, whereas, of course, by treatment

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Affinity
yeast for
arsenic.

Divergent
results
different
analyses

the Ro
case

Whether arsenic brewed with the beer or not makes no difference to the test.

with sulphuretted hydrogen our contention is that the whole of it is thrown down, and can be recovered by the mode which has been explained. In a third case, a sample which was received from Doncaster, and was analysed by Mr. Thomson, of Manchester, we were in substantial agreement with him. He found 1-20th of a grain; we found 1-15th of a grain. In all the other cases we have agreed substantially with the analysts. Mr. Lowe, of Chester, who analysed three samples of

beer, found only traces, and we returned the amount as about 1-100th of a grain.

7856a. (Chairman.) Will you put in this table?

(Professor Thorpe.) I think it would be convenient that that table should be put in as being an account of our work with such reference samples as have been received up to this time.

The following is the table referred to:—

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REFERENCE SAMPLES of Beer for Arsenic.

No.	Place.	Analyst.	Quantity of Arsenic per gallon certified by Analyst.	Government Laboratory Report.
1	Preston	Mr. Campbell-Brown	"A certain small quantity"	An appreciable trace estimated as not exceeding $\frac{1}{125}$ th of a grain.
2	Rechdale	"	$\frac{1}{10}$ th of a grain per gallon	$\cdot 033$ grain As_2O_3 per gallon.
3	Wolverhampton	Mr. Jones	$\cdot 07$ grain As_2O_3 per gallon	$\cdot 19$ grain.
4	"	"	$\cdot 05$ grain	No evidence.
5	"	"	$\cdot 09$ grain	$\cdot 38$ grain.
6	Ruabon	"	"Contains a certain amount of arsenic."	No evidence.
7	Doncaster	Mr. Thomson (of Manchester).	Found $\frac{1}{20}$ th grain	$\cdot 067$ grain = $\frac{1}{15}$ th of a grain.
8	Meld	Mr. Lowe	Traces of arsenic	$\frac{1}{125}$ th of a grain.
9	"	"	"	No evidence.
10	"	"	"	No evidence.

7857. (Chairman.) You can give evidence as to the amount of arsenic contained in beers brewed from arsenicated materials based upon the examination of samples representing 28,264 barrels of beer lodged by

67 brewers on making application for repayment of duty?—Yes.

The following are the tables:—

TABLE I.—EVIDENCE as to the amount of Arsenic in Beers brewed from Arsenicated Materials, based upon the examination of Samples taken on the receipt of applications for Repayment of Duty when the Beer was destroyed.

Total Number of Breweries	67
" " Barrels of Beers	28,264

Quantity of arsenic in beers on which rebate claimed.

County and Place.	Brewer.	Date of Brewing.	Arsenious Oxide Grains per Gallon.	Vendors of Sugar used in Brewing.	No. of Experiment.	
CHESHIRE :						
Macclesfield	North Cheshire Brewery	1900 : 31 Aug.	·42	Bostock & Co.	1	
		19, 27 Sept.	·24	"	2	
		20 Nov.	·28	"	3	
Stockport	Robinson, F.	22, 23 Nov.	·05	"	4	
CUMBERLAND :						
Penrith	Glasson's Brewery	15, 16 Nov.	·09	Bostock & Co. and Boake, Roberts & Co.	5	
		29 "	·18	"	6	
Workington	Workington Brewery	14, 22 Sept.	·13	Bostock & Co. and Freeman, Lloyd & Co.	7	
		12, 17 Oct.	·34	"	8	
		22, 23 Nov.	·24	"	9	
		29 "	·02	Freeman, Lloyd & Co. only.	10	See Note 1.
		7 Dec.	Trace	"	11	
DENBIGH :						
Wrexham	Lassell & Sharman	13 "	"	"	12	
		18 June	·19	Bostock & Co.	13	
		10 Aug.	·49	"	14	
GLOUCESTER :	Auty & Co.	6, 8 Nov.	·46	"	15	
		1, 6 Dec.	·44	Brewers' Invert Co. and Johnson's Saccharum Co.	16	See Note 2.
LANCASHIRE :						
Barrow	Case & Co.	26, 27 Nov.	·12	Garton, Hill & Co., Bostock & Co., and Clowes & Co.	17	

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County and Place.	Brewer.	Date of Brewing.	Arsenious Oxide Grains per Gallon.	Vendors of Sugar used in Brewing.	No. of Experiment.	
LANCASHIRE—cont.						
Blackburn	Holden, R.	1900:				
		26, 27 Oct.	30	Bostock & Co. and Rowell & Schofield.	18	
		13 Nov.	17	"	19	
		23 "	57	"	20	
		27 "	38	"	21	
	Whewell, T.	16, 17 Oct.	67	Bostock & Co. and Dutton & Co.	22	
		12, 13 Nov.	49	Garton, Hill & Co. Dutton & Co.	23	See Note 3.
		14, 16 "	29	"	24	
		21 "	40	Dutton & Co. and Bostock & Co.	25	
		22 "	43	"	26	
		23 "	49	"	27	
		26 "	53	"	28	
		14, 21 Nov.	23	Ince, Pickering & Co.	29	See Note 4.
		15 Aug.	58	Bostock & Co.	30	
		6, 8 Nov.	08	"	31	
		14 "	61	"	32	
		19 "	63	"	33	
		26 "	67	"	34	
		13, 20 Nov.	25	Garton, Hill & Co., Bostock & Co., and Diastatic Extract (name unknown).	35	
Chorley	Hilton, P.	26 Nov.	16	Bostock & Co.	36	
		24 May	12	"	37	
		3 July	20	"	38	
		27 "	37	"	39	
	Morton, W.	21, 30 Nov.	64	"	40	
		15, 16 "	52	"	41	
		Unknown	06	"	42	
		15, 31 Oct.	06	Bostock & Co. and Hallsworth Co.	43	
		7, 8 Nov.		Trier, Mayer & Co. and Freeman, Lloyd & Co.	44	See Note 1.
		1 Feb. 1901	Trace	Bostock & Co. and Liverpool Saccharine Co.	45	
Manchester	Mellor & Sons	1 Mar.				
		24, 27 Nov. 1900.	54	Bostock & Co. and Liverpool Saccharine Co.	46	
	Robinson's Brewery	21, 23 "	34	Bostock & Co.	47	
		26, 28 "	22	Bostock & Co. and Freeman, Lloyd & Co.	48	
	Tarbock's Brewery	22, 23 "	08	Liverpool Saccharine Co. and Bostock & Co.	49	
	Bedford Brewery	22 Nov.	07	American Climax, Bostock & Co. and Johnson's Saccharum Co.	50	
		23 "	20	Bostock & Co.	51	
		14 "	12	Bostock & Co. and Manbré Saccharine Co.	52	
		21 "	14	"	53	
		1 Oct.	16	Bostock & Co.	54	
		29 "	24	"	55	
		Unknown	20	"	56	
		23 Oct.	44	"	57	
		9 Nov.	28	"	58	
		14 "	06	"	59	
Nelson	Kay's Atlas Brewery	21, 23 "	35	"	60	
		26 "	28	"	61	
		Unknown	20	"	62	
		17 Nov.	57	Bostock & Co. and Valentine, Todd & Co.	63	
		27 "	20	Bostock & Co. and Manbré Saccharine Co.	64	
	Seed & Co.	22, 23 Nov.	21	Bostock & Co.	65	
		25 Sept.	32	"	66	
	Wilson's Brewery Co.	9 Nov.				
		16, 17, 19 Nov.	05	Garton, Hill & Co., Bostock & Co. and Liverpool Saccharine Co.	67	
	Worsley Brewery	14, 16 "	22	Bostock & Co.	68	
		19 "	03	Manbré Saccharine Co.	69	See Note 5.
		23, 30 Oct.	24	Bostock & Co. and Manbré Saccharine Co.	70	
	Astley's Executors	5, 6 Nov.	18	"	71	
		19 "	28	"	72	
		24 Sept.	52	Bostock & Co.	73	
		8 Oct.	90	"	74	
		20 Nov.	173	"	75	
Newton-le-Willows	Strickland, J.	27 "	300	"	76	
		26 "	62	"	77	
		End of Sept. or early in Oct.	72	"	78	
		1, 21 Dec.	87	Lichenstein & Co. and American glucose. (Name unknown.)	79	See Note 6.
			07			

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County and Place.	Brewer.	Date of Brewing.	Arsenious Oxide Grains per Gallon.	Vendors of Sugar used in Brewing.	No. of Experiment.
LANCASHIRE—cont.					
Oldham	Oldham Brewery Co.	1900 : Unknown		Bostock & Co. and Garton Hill & Co.	80
		"	-10	" E. D. M. E. Co." McFie & Co., Boake, Roberts & Co. and Lichenstein & Co.	81
Ormskirk	Ellis, Warde & Webster	9 Nov.	-36	Bostock & Co.	82
Poulton-le-Fylde	Catterall & Swarbrick	Unknown	-32	Bostock & Co. and Dutton & Co.	83
Rochdale	Phoenix Brewery	20 Nov.	-29	Ince, Pickering & Co.	84
		23, 26 "	-29	"	85
		29 "	-36	"	86
		18 Dec.	-07	" Dutton & Co.	87
Waterloo	Thoroughgood's Brewery	28 Nov.	-03	American Climax Co., and Bostock & Co.	88
Wigan	Oldfield Brewery Co.	27 Nov.	-04	Liverpool Saccharine Co. and Bostock & Co.	89
LEICESTER :					
Melton Mowbray	Langton & Sons	2, 9 Oct.	-87	Bostock & Co.	90
		20, 22 Nov.	-86	"	91
NOTTINGHAM :					
EVERTON	Farmer's Brewery Co.	7 June	-16	Bostock & Co., and Kendall & Son.	92
		2 Aug.	-21	"	93
		14 Sept.	-08	"	94
		17 Oct.	-14	"	95
		28 Nov.	-76	"	96
SHEPESHIRE :					
Market Drayton	Pearce's Crystal Fountain Brewery.	25, 28 Aug.	-65	Bostock and Co.	97
		25, 27 Sept.	-39	"	98
		9, 15 Oct.	-15	"	99
		9 Nov.	-58	"	100
		23, 26 Nov.	-31	"	101
STAFFORDSHIRE :					
Ashton-under-Lyne.	Scholfield & Son	27, 28 Nov.	-23	Ince, Pickering & Co.	102
Bardsley	Shaw & Bentley	21, 23 "	-76	"	103
Bilston	Harper, R. A.	28 Sept.	-31	Bostock & Co.	104
		26, 27 Nov.	-33	"	105
Burslem	Parker's Burslem Brewery Co.	1, 8 Oct. 1, 8 Nov.	-39	Liverpool Saccharine Co., Manbré Saccharine Co., and Bostock & Co.	106
Darlaston	J. Pritchard & Sons	20, 26 "	-03	"	107
		26 July	-58	Bostock & Co.	108
		13 Sept.	-102	"	109
Lichfield	Lichfield Brewery Co.	11 Oct.	-128	"	110
		29 "	-37	"	111
Newcastle	Ridgway & Sons	26 Nov.	-29	"	112
		29 Sept.	-07	Bostock & Co., Garton, Hill & Co., and Valentine, Todd & Co.	113
Stone	Joule & Sons	25 Oct.	-11	"	114
		19 Nov.	-72	Bostock & Co.	115
Walsall	Lord, J.	26 "	-36	"	116
West Bromwich	Bates, T. H.	25 Oct.	-25	Bostock & Co., and Kendall & Son.	117
WAEWICK :					
Birmingham	Birmingham Breweries Co.	16 Nov.	-28	"	118
		31 Oct.	-63	Bostock & Co., and Clark & Son.	119
		26 Nov.	-45	Bostock & Co., Brewers' Sugar Co., Greenock & Clark & Son.	120
	Dare, W.	10 Oct.	-147	Bostock & Co.	121
		8 Nov.	-105	"	122
		13 "	-113	"	123
		15 "	-101	"	124
		22 "	-94	"	125
	Evans, E.	28 "	-140	"	126
		13 Oct.	-69	"	127
		22 Nov.	-121	"	128
	Meade & Co.	11 Oct.	-40	"	129
		27 Nov.	-66	"	130
YORKSHIRE :					
Halifax	Brown and Brear	12 Oct.	-66	"	131
		12 Nov.	-15	"	132
Ilkley	Ilkley Brewery Co.	27 "	-32	"	133
Leeds	Albion Brewery Co.	23 Aug.	-22	Bostock & Co., London Glucose Co. (American), and Clark & Son.	134
Sheffield	Tomlinson, H., Ltd.	28 Sept.	-21	"	135
		17 Oct.	-19	"	136
		21 Nov.	-25	"	137
		28 "	-17	"	138
		20 Aug.	-58	Bostock & Co.	139
		29 Nov.	-04	"	140
1901					
Shipley	Seth, Senior, & Sons	14 Jan.	-34	Garton, Hill & Co.	141
		15 "	-27	"	142
		29 "	-05	"	143

See Note 4.

See Note 5.

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SUMMARY OF RESULTS.

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Proportion of Arsenious Oxide per gallon.	No. of Samples.
3 grains	1
1.0 grain but less than 2.0	9
0 " " 1.0	2
8 " " 9	3
7 " " 8	4
6 " " 7	11
5 " " 6	8
4 " " 5	11
3 " " 4	20
2 " " 3	29
1 " " 2	21
0.5 " " 1	14
Less than 0.5	10
Total	143

Number of Counties 11

NOTES.

1. May possibly be due to the malt used.
2. Sugar supplied by Brewers' Invert Co. said to have been manufactured by Bostock & Co.
3. Brewer states that Bostock's sugar was in stock, and may have been used in this brewing by accident.
4. Sugar supplied by Messrs. Ince, Pickering & Co., said to have been manufactured by Bostock & Co.
5. Yeast pressings from arsenicated beer added.
6. Yeast used stated to have been found by Brewer's chemist to contain arsenic.
7. Brewer, prosecuted by local authorities for selling beer containing arsenic, stated that the contamination had been traced by his chemist and was due to the malt used.

TABLE II.

TABLE showing the proportion of Arsenic present in beers brewed in successive months from May to November, 1900.

Month.	Number of Experiment in Table I.	Arsenious Oxide. Grains per Gallon.	Month.	Number of Experiment in Table I.	Arsenious oxide. Grains per Gallon.
May	37	12	November	3	28
June	13	19		4	05
	92	16		5	09
July	38	20		6	18
	39	37		9	24
	108	58		10	02
August	1	42		15	46
	14	49		17	12
	30	58		19	17
	93	21		20	57
	97	65		21	38
	134	22		23	49
	139	58		24	29
September	2	24		25	40
	7	13		26	43
	72	52		27	49
	94	08		28	53
	98	39		29	23
	104	31		31	08
	109	1.02		32	61
	113	07		33	63
	135	21		34	67
October	8	34		35	25
	18	30		36	16
	22	67		40	64
	53	16		41	52
	54	24		45	34
	56	44		46	34
	69	24		47	22
	73	90		48	08
	90	87		49	07
	95	14		50	20
	99	15		51	12
	110	1.28		52	14
	111	37		57	28
	114	11		58	06
	117	25		59	35
	119	63		60	28
	121	1.47		62	37
	127	69		63	20
	129	40		64	21
	131	66		66	05
	136	19		67	22
				68	03
				70	18
				71	28
				74	1.73
				75	3.00
				76	62
				82	36
				84	29
				85	29
				86	36
				88	03
				89	04
				91	86

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Month.	Number of Experiment in Table I.	Arsenious Oxide. Grains per Gallon.
November	100	·58
	101	·31
	102	·23
	103	·76
	105	·33
	107	·03
	112	·29
	115	·72
	116	·36
	118	·28
	120	·45
	122	1·05
	123	1·13
	124	1·01
	125	·94
	126	1·40
	128	1·21
	130	·66
	132	·15
	133	·32
	137	·25
	138	·17
	140	·04

SUMMARY.

Month.	May.	June.	July.	August.	September.	October.	November.
Number of Samples	1	2	3	7	9	21	80
Average As ₂ O ₃	·12	·17	·38	·45	·33	·50	·42

It will be seen from the foregoing tables and the summaries annexed to them that the proportion of arsenic found varied from less than five-hundredths of a grain up to half a grain per gallon in something like three-fourths of the whole number of cases, but that as regards the remaining fourth, the quantity of arsenic ranged from half a grain to about one and three-quarter grains, with one exceptional case of three grains to the gallon. It has been already remarked that a large proportion of these contaminated beers were drawn from the counties of Lancashire, Staffordshire, and Yorkshire, but one sample was brewed at Bristol. In all but 18 instances Bostock's sugar wholly or in part had been used, either in the production of the beer or in priming. In eight out of the eighteen cases where sugar obtained from Messrs. Bostock directly had not been employed it was stated that the sugar, though supplied by another firm, had been manufactured by Bostock; in two instances it was found that the arsenic was due to the use of yeast or of yeast pressings from contaminated beer; in one instance the brewer stated that Bostock's sugar was in stock at the time, and might have been used by accident, and in the remaining seven cases it was alleged that the arsenical contamination had been traced to the malt used. As regards the period over which the arsenical contamination extended, it will be noted that the oldest sample examined was brewed on the 24th May, 1900. Beer at the present time is consumed very shortly after it is produced, and consequently, whilst there are many samples representing the November production—the date at which the contamination was detected—considerably fewer samples of beer produced at earlier dates are available. It may, however, be noted that in the one May sample the proportion of arsenious oxide per gallon was 0·12 grain, the two brewed in June contained 0·16 and 0·19 grain respectively.

7858. All of the same brewery?—No; they are from different breweries. This is regarding them merely in point of time. The three July samples all showed higher proportions of arsenic, and in one case exceeded half a grain to the gallon; in August the average of six samples is 0·45 grain per gallon, and one sample contained 0·65 grain; in September the average is slightly lower (0·33), but one sample contained rather more than one grain of arsenious oxide per gallon; in the October beers, the average is half a grain per

gallon, and of the twenty-one samples eight contained more than this—two, from different breweries, containing as much as 1·47 and 1·23 grain per gallon, respectively, though it should perhaps be pointed out that these were in both cases strong beers, the original gravities being 1,076° and 1,066° respectively. As regards the November samples, the average is 0·42 grain of arsenious oxide per gallon, but there are seven samples in which the contamination exceeds one grain, and in one exceptional case the proportion rises to three grains per gallon, the largest proportion shown by any of the samples. This exceptional amount of arsenic was found in a sample of stout (Expt. No. 75) brewed by the executors of William Astley, at Nelson, Burnley, on the 27th November. The result was confirmed by the examination of a duplicate sample, but no sample of the sugar used, which was described as Bostock's 'Caramelised glucose,' could be obtained. Another sample of stout produced at the same brewery (No. 74) showed the next highest amount obtained, viz., 1·73 grains per gallon. This was brewed on the 20th November, and half the quantity of sugar used in this brewing was said to be of the same consignment as was employed in the brewing of the 27th November, the other half being of a previous consignment.

7859. Was the same quantity of sugar used in each case, on the 20th and 27th November?—On the 20th November the materials used were 128 bushels of malt and 895 pounds of glucose. On 27th November the materials used were 110 bushels of malt and 672 pounds of glucose. The proportion of sugar to total materials was in the first case 18 and in the second case 16 per cent. No priming was used in the second case, but in the first case it was primed by the addition of Bostock's "porter heading."

7860. (Sir William Church.) There was not a very great amount of difference?—No; 16 and 18.

7860a. (Professor Thorpe.) The difference is probably in the priming?—That is not included.

7861. In one case the beer was primed; in the other case not?—Yes, that is so.

7861a. (Chairman.) The beer on the 27th November contained three grains per gallon, and no priming was used?—That is so.

7862. The beer brewed on the 20th November contained a smaller quantity of arsenic—1·73 grains per gallon?—Yes.

7863. Half the quantity of sugar used in this brewing was said to be of the same consignment as was employed in the brewing of the 27th November?—That is so. The much larger proportion of arsenic in the beer brewed on the 27th November therefore points to the later sugar being more highly contaminated than that delivered earlier. Two beers brewed at the same brewery on 8th October and 24th September, respectively (Nos. 73 and 72) contained arsenic equal to 0·90 and 0·52 grains of arsenious oxide per gallon, and no explanation of the exceptional degree of contamination shown by the two stouts has been found, black beers from other breweries containing less rather than more arsenic than the ales. The strength of the beer in every case has, of course, some bearing upon the quantity of arsenic present, for the original gravity of the samples analysed varied from 1,037° to, in one case, 1,080°, the arsenious oxide in the latter case (No. 123) amounting to 1·21 grain per gallon. In the case of six samples from a Birmingham brewery (Nos. 12) 126) the beer of the highest original gravity, 1,076 (No. 121) contained 1·47 grain of arsenious oxide per gallon. The remaining five samples had an original gravity of 1,063·4°; in one the arsenious oxide amounted to 1·40 grain per gallon, whilst in the other four it varied between 0·94 and 1·13 grains per gallon. Generally, however, the original gravity of the beers was much lower than those just mentioned, and in a large proportion of the whole number lay between 1,040° and 1,057° with an average of about 1,055°. After the evidence which has been given before the Commission, it is unnecessary to further prove that the serious arsenical contamination of these beers was due to certain of the sugars employed in their production. The results of the examination of such sugars are given in Tables III. and V., and, as bearing upon the proportion of arsenic found in the beers, it is only necessary here to allude to the very varying proportions in which sugar was employed. The highest proportions of sugar to malt and grain used were 50 per cent. and 47 per cent. respectively, of the total brewing materials, and in neither case did the arsenious oxide ex-

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Greatest amount of arsenic found in any of the beers.

contaminated by arsenic.

Highest ratio of sugar to malt in arsenical beers on which rebate claimed.

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ceed 0.60 grain per gallon, but such proportions of sugar were exceptional. The lowest proportions of sugar were less than 1 per cent., and in two out of three of these the arsenic found in the beer was 0.03 grain of arsenious oxide per gallon, though in the third case (Expt. No. 67) it amounted to 0.22 grain per gallon. The average proportion of sugar used in the production of these beers was 8 per cent., and in the two beers showing the highest degree of contamination the proportions were 16 per cent. and 18 per cent. respectively. In many cases, however, the sugar employed was obtained from more than one firm, and no evidence has been obtained at the Government Laboratory that the brewing sugars generally in use during the past year were contaminated with arsenic. No sample of malt known to have been used in the production of these beers has been obtained, but the proportion of arsenic found in malts in use in various parts of the country between June and November I refer to later.

Arsenic in
Non-Bostock
beer.

7864. (Dr. Whitelegge.) In Table I. in some instances there is nothing said about sugar. Does that mean that no sugar was used, or that the information is not available?—In the production of all of these beers sugar was used.

7865. In Note 7 to that table: "It was alleged that the contamination was traced by the brewers' chemist to the malt," and I see by the table that in that case the amount of arsenic found was 0.34 grains per gallon. May we take that as well authenticated?—We can only state the facts. These particular beers were brewed in January of this year.

7866. At all events, the glucose in that instance was from a source we had not had associated with arsenic so far?—That is so.

7867. I suppose, as a matter of fact, if one went carefully through this table looking, not to date of brewing, but to locality of the breweries, the quantities of arsenic would be found to vary a great deal—for instance, the Birmingham results vary a good deal?—The greater number of these happened to be strong beers. I emphasised that point. Obviously the proportion of material in a strong beer is greater than in a weaker beer, and you might reasonably expect if part of that material is arsenical you would get a larger arsenical content.

7868. Bearing in mind those local differences, are we quite on safe ground in assuming from the figures you give us that there was a general increase in arsenical

contamination month by month?—It seems to me there was certainly an increase of arsenical contamination up to July. After July the increase was not very considerable. Although there are a large number of cases where more than a grain per gallon was shown, if you work it out on the total number of samples the percentage is pretty much the same. From July to November a fairly steady average is obtained—33 to 50—but there are an increasing number of instances of the higher quantities—that is, above a grain per gallon. In September there was one, in October two cases, in November there were seven cases, with one at 0.94. But as a percentage on the total number of samples examined the difference was not great—that is, the percentage of those over one grain was 11, 13, and 10 for the three months I have given you. So that one must make allowance for the larger number of samples when one fixes one's eyes on the larger quantities found.

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7869. (Chairman.) You have evidence as to the amount of arsenic contained in brewing materials, based on the examination of samples forwarded to the Government Laboratory by Excise officials?—Among the samples sent for examination in connection with the arsenicated beers there were three unfermented sugar solutions which were found to contain arsenic equal to 7.99, 8.14, and 2.62 grains of arsenious oxide per gallon. These were priming solutions prepared on the 23rd, the 28th, and the 24th November respectively, the first two from invert sugar and "fluid" sugar respectively, both manufactured by Bostock and Company, and the third, which was described as "black priming solution," from equal quantities of Bostock's invert sugar and of caramel from a maker whose name could not be ascertained. The calculated proportions in grains of arsenious oxide per pound of sugar used were 1.66, 1.74, and 1.09 respectively, the last being calculated on the invert sugar alone. Three samples of invert sugar and one sample of solid glucose, all stated to be of Bostock's manufacture, were also sent for examination in connection with the applications for repayment of duty on the destroyed beer. The three samples of invert sugar were found to contain arsenic equal to 2.04, 1.83, and 1.67 grains of arsenious oxide per pound respectively, whilst the quantity in the solid glucose was 1.99 grains per pound. Samples of solid and liquid caramel used in brewings of arsenical porter and stout were found to be free from arsenic, and it was stated that these were not obtained from Messrs. Bostock. All these results are embodied in Table III.

Arsenic
sugars for-
warded
Govern-
ment
Laborat

TABLE III.—PROPORTION of Arsenious Oxide found in Brewing Sugars forwarded for examination in connection with samples of Beer known to contain Arsenic.

with samples of beer known to contain arsenic.

Progressive Number.	Date of Sampling of Sugar or of Preparation of Solution.	Description of Sugar.	Proportion of Arsenious Oxide.		Vendor or Manufacturer of Sugar.
			Grains per pound of Sugar.	Grains per gallon of Solution.	
1900.					
1	Nov. 23 - -	Priming solution of invert sugar	1.66 =	7.99	Bostock & Co.
2	" 24 - -	Black priming solution prepared from equal quantities of invert sugar and caramel	1.09 = (calculated on invert sugar alone.)	2.62	Invert sugar from Bostock & Co. Caramel from another source (unknown).
3	" 28 - -	Priming solution of invert sugar	1.74 =	8.14	Bostock & Co.
4	" 30 - -	Invert sugar - - - -	2.04	-	Ditto.
5	Dec. 5 - -	Ditto - - - -	1.83	-	Ditto.
5	" - - -	Glucose - - - -	1.99	-	Ditto.
1901.					
{	7 Jan. 25* - -	Invert sugar - - - -	1.67	-	Ditto.
	8 " 25 - -	Solid caramel - - - -	Nil.	-	-
	9 " 25 - -	Liquid ditto - - - -	-	Nil.	-

*Kept over at Brewery from November (unused).

E. G. 7870. You have also evidence as to the amount of arsenic contained in brewing materials based upon the examination of samples forwarded to the Government Laboratory by Excise officials for the determination of brewing value?—The sugars we have already dealt with were directly connected with the arsenical beers alluded to in Table I. The samples I am now going to allude to were sent up previous to the detection of arsenic in beer, and were forwarded from various parts of the country by Revenue officials. As regards the samples of brewing materials forwarded by Excise officers to the laboratory, it may be stated that as a rule these samples are preserved for three months after receipt, and at the end of that time, unless otherwise ordered, are destroyed, storage for a longer period being impossible on account of the large number and variety of articles received for examination. On the discovery of the arsenical contamination of beer all the brewing materials in store or under examination were placed aside to be tested for arsenic, and 104 samples of sugar with 48 samples of malt have since

been examined. The sugars included samples taken at breweries in each of the months from June to November, and the total was made up of 64 glucoses and 40 invert and priming sugars. Of these six samples of glucose and two invert sugars were found to contain arsenic. These samples are classified in Table IV. In four instances the proportion of arsenic was found to be larger than that in the sugars obtained for examination in connection with the arsenicated beers, particulars of which have been already given. All the arsenicated samples were drawn from the North of England, and with one exception were probably of Bostock's manufacture, whilst only a small proportion of arsenic was found in this excepted instance. The full particulars as to these contaminated sugars are shown in Table V, whilst in Table VI, a list of places is given from which the non-arsenicated sugars were drawn. Fourteen samples of glucose and six samples of invert sugar taken from breweries during March of this year were all found to be free from arsenic.

Mr. E. G. Hooper.
13 May 1901.

Arsenic in Non-Bostock beer.

TABLE IV.—PARTICULARS as to Brewing Sugars forwarded by Excise Officials for Examination as to Brewing Value, and afterwards Tested for Arsenic.

Month in which Sampled at Brewery.	Number and Description of Samples.		Number of Samples found	
	Glucose.	Invert and Priming Sugars.	Free from Arsenic.	Containing Arsenic.
June 1900	4	3	6	1
July "	8	4	10	2
Aug. "	5	4	8	1
Sept. "	14	17	28	3
Oct. "	9	6	15	Nil.
Nov. "	24	6	29	1
	64	40	96	8

Note.—Particulars as to the above arsenicated sugars are given in Table V., and a list of places from which the non-arsenicated sugars were drawn appears as Table VI.

TABLE V.—PARTICULARS as to the Brewing Sugars shown in Table IV. as having been found to contain Arsenic.

Progressive Number.	Date of Sampling.	Place of Sampling.	Description of Sugar.	Arsenious Oxide found.	Vendor or Manufacture of Sugar.
				Grains per lb.	
1	June 29, 1900 . . .	Chester	Glucose . . .	1.21	Bostock & Co.
2	July 10, "	Liverpool	"	1.44	Uncertain.
3	" 19, "	Ardwick, Manchester . . .	"89	Bostock & Co.
4	Aug. 8, "	Liverpool	"	3.28	Ince, Pickering & Co.
5	Sept. 4, "	Blackburn	Invert sugar . . .	3.21	Bostock & Co.
6	" 12, "	Oldham	"	3.09	Bostock & Co.
7	" 15, "	Bardsley	Glucose . . .	2.67	Ince, Pickering & Co. ("probably Bostock's manufacture").
8	Nov. 8, "	Longtown, Cumberland . . .	"69	Paisley Sugar Company, St. Mirren's Works, Paisley.

Note.—In connection with the arsenical beers shown in Table I. it has been mentioned that the sugar sold by Messrs. Ince, Pickering and Co. was manufactured by Messrs. Bostock and Co.

Mr. E. G. Hooper. TABLE VI.—List of Places from which Samples of Brewing Sugars found to be free from Arsenic were obtained in the Months from June to November, 1900.
13 May 1901.

ENGLAND AND WALES.

Appleby.
Birmingham.
Blackburn.
Bradford-on-Avon.
Brockhampton.
Bury St. Edmunds.
Galne.
Canterbury.
Caerleon.
Carlton.
Cardiff.
Chard.
Colne.
Crangoose.
Crumpsall.
Daybrook.
Derby.
Ditchingham.
Dolgelly.
Hartlepool.
Hastings.
Hayle.
Heckmondwike.
Helston.
Hitchin.
Ironbridge.
Kimberley.
Leemingbar.
Leeds.
London.
Lowestoft.
Malton.
Manchester.
Market Drayton.

Newark.
Newport (Isle of Wight).
(Salop).
Northampton.
Norwich.
Nottingham.
Old Basford.
Oldham.
Ormskirk.
Penrith.
Perry Bar.
Petersfield.
Pontardawe.
Rugby.
Rye.
Scarborough.
Shelton.
Sherburn.
Sidmouth.
Smethwick.
Somerton.
Stambourne.
Stow-on-the-Wold.
Stroud.
Tadcaster.
Taunton.
Thornton-le-Moor.
Walmersley.
Wakesfield.
Wavertree.
West Bromwich.
Wetherby.
Willenhall.
Wolverhampton.

SCOTLAND.

Aberdeen.
Broughton Ferry.
Craig Millar.
Dumbarton.

Glasgow.
Montrose.
St. Andrews.

Meaning of "freedom from arsenic" when applied to sugar.

7871. (Chairman.) What does "free from arsenic" mean at the Government Laboratory? Does it mean free from arsenic which can be separated and weighed from a litre of beer or from 100 grammes of sugar, or do you apply a qualitative test as well?—It means such a quantity of arsenic as is not shown by the Marsh test when tested upon 20 grammes of sugar.

7872. The test from 100 grammes of sugar would be analogous to the test from a litre of beer?—It would.

7873. If it has been declared free from arsenic by the Marsh test on 20 grammes of sugar?—That is so.

and to beer.

7874. And as regards beer, when has that been declared arsenic free?—When the Marsh test showed no reaction for arsenic with not less than 50 cc.

7875. Can you say how much arsenic there might be in a gallon of beer escaping that test?—There is no evidence that there is any.

7876. If there was 1-100th of a grain of arsenic per gallon would it be shown?—Readily.

7877. 1-200th?—Then it becomes doubtful.

Maximum amount of sugar which might be used in beer

7878. (Professor Thorpe.) What amount of sugar could there conceivably be in a litre of beer, used in the fermentation or in the priming?—Taking 1,080°, which is very strong beer, 20 grammes per 100 c.c. or 200 grammes per litre, supposing the whole of the gravity to be due to sugar.

7879. Assuming that the beer had a mean density of 1055°, what is the maximum amount of sugar that could be used in the formation of that beer?—1.771 lb. per gallon.

7880. How much would that be in a litre?—Roundly, it would be 142 grammes of sugar per litre of beer at 1.055 gravity.

Quantities of arsenic found in malt.

7880a. (Chairman.) With regard to malt taken from breweries during the months from June to November of last year, you say that all but six afforded evidence of the presence of arsenic, but the highest proportion of arsenic was only 0.05 grain of arsenious oxide per pound of malt?—That is so.

7881. In 22 samples the arsenious oxide per pound of malt lay between 0.05 and 0.02 of a grain?—Yes.

7881a. And that in 19 cases, whilst still showing traces, the quantity was less than 0.02 per pound of malt?—That is so.

7882. Of the malt samples received during the month of March three contained from .05 to .02 of a grain of arsenious oxide per pound, five contained traces amounting to less than .02 grain per pound, and one only was quite free from arsenic?—That is so.

7883. (Professor Thorpe.) Can you tell the Commission how much arsenic there would have been in a litre of beer if the whole of that beer had been brewed from malt, and the amount of arsenious oxide in the malt used was the maximum? You found .05 of a grain per pound of malt. How arsenicated would that beer be, assuming that the whole of the arsenic went in?—16 of a grain per gallon if the whole of the arsenic present in the malt to the extent of .05 grain per pound had gone into the beer.

7884. Are you quite right there?—I think so. It is below what has been said by Dr. Campbell Brown, for instance, to have been found in an all-malt beer.

7885. How much malt goes to a gallon of beer, roughly speaking?—2.33 lb. I said .16, but it is really .116.

7886. (Chairman.) 2.33 times .05 is .12 nearly?—Yes, .116 exactly.

7887. You have evidence as to the presence or otherwise of selenium in brewing sugars obtained at various times during the past ten months?—In view of the possibility that brewing sugars prepared or treated with sulphuric acid might possibly contain selenium, it was felt to be necessary that search should be made for this substance. The samples of solid sugar and of prepared sugar solutions which had been used in the preparation of beers proved to be arsenicated were first examined. These samples were received directly from the breweries, and full particulars as to the description of sugar, arsenical content, date of sampling, etc., have been given in Table III. In no case was any selenium found to be present in the sugar or sugar solution. The sugars enumerated in Table V. were next examined, and were also found to be free from selenium. These samples include all the sugars found to be arsenicated of those sent for examination by Excise officials throughout the United Kingdom between June and November last. Finally, a selection of the non-arsenicated sugars forwarded for examination from various parts of the country between June and March last were tested for selenium, but in these samples also no selenium could be detected. It should perhaps be stated that when traces of selenious acid were added to glucose or invert sugar the presence of selenium was readily demonstrated. No evidence of the presence of selenium in brewing sugars—glucose or invert—has therefore been obtained at the Government Laboratory.

No evidence of selenium in Boston sugars.

or in other sugars.

7888. You have evidence also as to the presence or absence of arsenic in imported brewing sugars?—The samples of brewing sugars obtained from various parts of the country, and classified in Tables V. and VI., probably represent with a very considerable degree of completeness the whole of the sugars, whether of home or foreign manufacture, in common use by brewers in the United Kingdom. To render the investigation even more thorough, however, samples of brewing sugars were taken by the Customs authorities from importations extending over a month. One hundred and seventy-seven samples in all were received, consisting of solid and liquid glucose, caramel and syrups, described as "molasses." These samples were received from the United States of America, Germany, Belgium, Holland, and Canada. With two exceptions, all these samples were found to be free from arsenic. The two samples in which evidence of arsenic was obtained consisted of liquid glucose, imported, at London and Hull, respectively, in both cases from Stettin. The amount of arsenic was small. The exact quantities in the two instances are .02 and .01 grain per pound respectively.

Arsenic German glucose.

7889. Were these samples from Belgium, Holland, and Canada made in those places?—We cannot say. We only know that they were imported from there. Certain marks are on the packages, which, on investigation, might possibly lead to some information being obtained, if the Commission deem it of importance.

7889a. (Professor Thorpe.) The Customs will have no information?—No.

Mr. E. Hooper.

13 May 1901

E. G. Cooper. 7890. In the case of Holland and Belgium, for instance, it might be German glucose which came down the Rhine?—I think so.

May 1901. 7891. (Chairman.) Are these imported sugars all glucose?—They were glucose, caramel, and other sugars, which are imported according to the Customs regulations, as molasses, that is to say, they are of the character of treacle.

7892. With regard to the evidence of the presence or absence of arsenic in beer supplied by Government contractors for Army and Navy use, have you anything to say on that?—All samples of beer supplied under Government contracts which have been submitted for analysis since December last have been examined for arsenic. Forty-six samples of this class have been received, and 45 of these were found to be free from arsenic, whilst one War Office sample contained about one-hundredth of a grain of arsenious oxide per gallon (0.11 grains), and was so reported.

7893. Do you, as a matter of routine, have beer intended for Army and Navy use sent to you for examination?—Not quite as a matter of routine, but samples come frequently at rather irregular intervals, taken as those in charge of the contracts, or the inspecting officers, deem necessary.

7894. To test for quality?—Yes.

7895. And for freedom from noxious substances?—That has been included.

7896. Did you ever test them for arsenic before the recent outbreak?—No.

7897. (Professor Thorpe.) These beers for the Government service, whether for the Army or Navy, are tendered according to the specification of gravity, etc., and it is your duty to see how far the beers conform to the specification?—Yes.

7898. As a matter of fact we have under consideration now the revision of the terms of the specification, in view of this scare?—Yes.

7899. (Dr. Whitelegge.) In the event of any mischief

being associated with beers supplied for the Army or the Navy, would samples come to the Government Laboratory for examination?—We have had one case of vinegar some three or four years ago. There was a case of poisoning at Portsmouth. They did not know what was the cause, but vinegar was stated to have caused the illness of 17 men. I directed it should be searched, for second group metals, which include lead, arsenic, and copper, and we readily found arsenic in fairly considerable quantity. Samples of the vinegar were afterwards sent as received direct from the vinegar manufacturer, and those samples of vinegar were found to be quite free from arsenic. That is the only case we have had.

7900. (Chairman.) Was there any explanation of how the arsenic got into the vinegar in that special case?—The military officials had an inquiry, but it was never published, and we are not acquainted with the result arrived at.

7901. How much arsenic did you find?—A very large amount; 230 grains, if I remember rightly, but I should like to refresh my memory.

7902. (Chairman.) That could not be a mere accident?—No, it was malicious.

7903. (Dr. Whitelegge.) There has been no recent occurrence of illness amongst troops or sailors attributed to beer, which has come to your notice?—None whatever.

7904. Was not there something of the kind last year amongst volunteers in camp somewhere?—I have a faint recollection of having seen something, but I am afraid I cannot recall the exact particulars.

7905. If there had been arsenic found you would have known of it?—Yes.

7906. (Chairman.) If we have any further questions to ask on any of the evidence which will be before us in print, we may perhaps wish to see you again?—I shall be quite prepared to attend.

Mr. E. G. Hooper.
13 May 1901.

Arsenic in vinegar at Portsmouth.

Added maliciously.

SEVENTEENTH DAY.

Tuesday, 21st May, 1901.

PRESENT:

The Right Hon. Lord KELVIN (in the Chair).

Sir WILLIAM CHURCH.
Professor THORPE.

Mr. COSMO BONSOE.
Dr. WHITELEGGE.

Dr. BUCHANAN, *Secretary*.

Mr. OTTO HEHNER, called; and Examined.

Mr. Hehner. 7907. (Chairman.) You are public analyst for Nottinghamshire, West Sussex, the Isle of Wight, and the boroughs of Derby and Ryde?—Yes.

May 1901. 7908. And past President of the Society of Public Analysts and Chairman of the London section of the Society of Chemical Industry?—Yes.

7909. You have given considerable attention to the question of arsenic in ingredients of food and in commercial products?—I have.

7910. Will you kindly tell the Commission what you have found?—I have analysed a very great number of samples of beer from different parts of the country, also malts and chemicals which are used in the manufacture of beer, and, as a general experience, I may say, that it is exceedingly rare that I find a sample of beer which is totally devoid of arsenic. The same thing applies to malt. I doubt whether I ever found a single sample of malt which is totally free from arsenic. I would draw from that the conclusion that whilst the present system of malting and brewing is in practice, it is impossible to expect a beer to be quite free from arsenic.

7911. You speak of the present system of malting; but what characteristic of the present system do you refer to?—To the system of malting where the fumes of coal come in contact with the malt. Of course, on the Continent, malting is largely on an entirely different system of drying from what is in this country, and a system which is not, under present circumstances, applicable in England.

7912. Why should it not be applicable in England?—Because it would mean the reconstruction of all the malting ovens, which is rather a large order at the present time. I think gradually there might be a change unless meantime other means are found to retain the arsenic in coal. I have every hope that partly by careful selection of the fuel and partly by chemical treatment of the fuel, arsenic will be kept out of malt much more than hitherto has been the case. Already, as far as my experience goes, most maltsters are exceedingly careful in the selection of their fuel, which was not the case a few months ago, and methods are being tried with the intention, and, I think, with every hope, of retaining the arsenic in the coal. It is a very curious fact that in the burning of the coal or arsenic.

Mr. O. Hehner.
21 May 1901.

How arsenic in beer may be reduced.

Treatment of malting fuel in order to fix the

Mr.
O. Hehner.
1 May 1901.

coke, the arsenic does not entirely, or only to a small proportion, volatilise. One would imagine that arsenic was volatile at the high temperature of a furnace with a reducing agent present, but as a matter of fact the bulk of the arsenic remains in the ash, and I believe it is practicable or probable that the rest of the arsenic can be also retained. Therefore I say under the present conditions of malting I think you cannot expect freedom until some change has been brought about either in the mode of drying or in the mode of combustion.

Most of
arsenic in
coal remains
in the ash.

7913. Have you ever analysed the ash of various kinds of coal for arsenic?—Yes. I have never found one free. I have made quantitative determinations of the proportion of arsenic which is left in the ash, and the proportion which is volatile, and by far the greater portion, sometimes as much as 9-10ths, remain in the ash, and only 1-10th goes away, but sometimes more is volatile, although the bulk remains in the ash.

7914. Does it remain in the ash in a form from which it would not volatilise if heated to redness for instance?—It will not volatilise. I do not know in what form it may be, whether arsenate or arsenite of iron, but it is not volatile and not reducible by the carbon into elementary arsenic which would go away. But of course in a malting furnace there is always a considerable amount of coal dust flying about, and that dust is always arsenical.

7915. You consider that it is in combination with iron in the ash?—I have no direct evidence; one can only form ideas about it. I have no evidence whatever.

7916. Do you think there is any other objection than the expense to the Continental method being introduced into England?—I have not sufficient knowledge of the practical requirements of the brewer, and I can only say from hearsay, which is not worth much, that the Continental system of malting has been tried here, and has not given very good results. I, personally, know nothing about it.

7917. You do not know in what respects the results were inferior?—The suggestion is that the flavour of the smoke, as produced by the coal fumes, is required in English beer.

Continental
system of
malting.

7918. Can you describe the Continental method of drying the malt?—The malt is dried on impervious floors, metal floors often.

7919. Flat floors?—Yes, as far as I know.

7920. Are those floors heated?—Yes, by flues underneath, or by a double floor where the products of combustion of the furnaces go through.

7921. Do you know to what temperature the solid floor is heated?—I do not.

7922. Is the floor iron or stone?—When I knew it it was iron, but I am not a practical maltster, and I can hardly presume to give definite evidence on the point.

7923. Would any special arrangement be made for a current of air to be driven through the malt?—I do not know.

Traces of
arsenic in
refined sugar

7924. You have found minute traces of arsenic in some kinds of sugar?—Yes. I have examined numerous samples of sugar, and I have found them mostly to be free from arsenic, but in a number of cases I found even in refined sugars exceedingly minute traces, but still quite plainly discernible. The same applies to molasses, the refuse from sugar refining, and there I found in a few cases minute traces of arsenic.

7925. When you say "minute traces of arsenic in sugar," about how much would that be?—I think up to about .005 grains per pound; 1-200th of a grain per pound.

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7926. And in molasses a greater quantity or about the same?—About the same.

7927. You found arsenic in some other substances—salts of sodium and potassium?—Sodium carbonate almost invariably; potassium carbonate almost invariably; sulphites, traces and more than traces.

7928. Larger quantities sometimes in sulphites?—Sometimes, but at present, where a great deal of attention has been drawn to it, the quantities are exceedingly minute, but absence, I think, cannot be insured.

in borax.

7929. Borax?—Yes, I have found considerable traces.

7930. About how much?—I have never determined it.

7931. Oxide of iron?—Yes, I should say in sulphate of iron sometimes very definitely, and in oxide of iron, which is obtained from sulphate, and used for colouring of chocolate and bloater paste, and so on, very strong traces of arsenic, up to 1-10th or more grains per pound—in oxide of iron which resulted from the heating of the sulphate of iron.

7932. These articles are all used for food materials?—Yes.

7933. Do you think the arsenic which may thus be introduced into the food is liable to be in poisonous amounts?—I think not. What I wish mainly to point out is, at present it is not reasonable to expect absolute freedom. I would wish that beer and food material could be free, but I do not see the possibility. I take, as an analyst, the greatest pains to get arsenic-free materials, and it is almost an impossibility. Even when I get from the very best makers pure so-called arsenic-free acid, I, as a rule, have to subject it to a further process of purification, and even when pure one day it may be impure the next, because I have found, with a number of my colleagues, that hydrochloric acid especially takes up arsenic from the glass bottles in which it is stored.

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7934. Is there arsenic in the composition of the glass?—Of much glass, of white glass, as a rule; also of blue Winchester quart bottles. I have found in several cases acid quite pure stored in Winchester quarts has got arsenical from an analytical point of view, not to an extent capable of producing ill effects.

7935. Do you refer to hydrochloric acid, sulphuric acid, or both?—To both, but mainly to hydrochloric acid. Hydrochloric acid seems to attack the glass more than sulphuric.

7936. Have you any suggestion as to sulphuric acid brought into commerce?—I think that no sulphuric acid should be sold unless it has been subjected to a de-arsenicating process, or unless it is labelled "arsenical." There is, I believe, no great difficulty and no great expense connected with the practical removal of arsenic from sulphuric acid and manufacturers not using it in their own works, I think ought to sell it after it has undergone a de-arsenicating process, because the makers of sulphuric acid are comparatively few, while the users of sulphuric acid are many.

7937. With regard to sulphuric acid made from Sicilian brimstone, should you say that required de-arsenication?—From what I have said before, it follows that I do not mean the complete removal, which, I believe is from an analytical point of view commercially impossible, but it should not contain more than a certain quantity, to be laid down. In that case I should think that Sicilian brimstone-made acid would require in most cases no purification, although it may contain traces of arsenic.

7938. If acid is not arsenic-free in the sense you have explained, do you think notice should be given by the vendor?—I think it should be labelled. I think the notice should be incumbent on those who sell arsenical acid, not on those who have subjected it to a process. At present, if you buy acid, and you obtained a bottle labelled sulphuric acid, it is almost certainly arsenical. If you want it pure you get a separate label "free from arsenic," or "freed from arsenic." I think it should be the contrary. Sulphuric acid should be pure unless the contrary is notified.

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7939. Sulphuric acid not free from arsenic should be labelled "not free from arsenic"?—Yes, within limits to be laid down.

7940. Are you of opinion that a maximum limit should be laid down in respect to freedom from arsenic of any brewed beverage?—Yes, I think from my experience in most cases now the amount of arsenic is somewhat less than 1-100th of a grain per gallon, and I think from the experience I have collected both from analytical examination of beer and from experience with brewers, that 1-100th of a grain per gallon need not be exceeded with reasonable care. When I calculate it back to malt, that would come to about 1-100th of a grain per pound in the malt, and I do not think that need be exceeded. In fact, it might be somewhat less at the present time.

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7941-2. In the case of beer and beer ingredients, a Committee of the Society of Chemical Industry is now engaged. I believe?—Yes, we have appointed a Committee, mainly with the view to settle upon a process for the detection and approximate estimation. We are all convinced that absolute freedom cannot be obtained, and that therefore limits will have to be laid down,

Mr. Hehner. and we are anxious to find a method which shall be easily applicable and reasonably accurate, which could be adopted by all persons concerned.

May 1901.

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7943. Can you give any provisional information or opinion regarding tests for arsenic?—I can give no official information, because the Committee has not arrived at a conclusion. I could give my own working and my own opinion, but I do not know whether that is worth having any more than that of any other analyst who has concerned himself with the question. I have personally always employed the Marsh method direct to the beer, working on very small quantities of beer, hardly ever using more than 10 cc. There are hardly any beers where in 10 cc. I cannot find a feeble trace of arsenic under rigid test conditions. I think this test when carefully carried out is the most sensitive and, for quantitative purposes, dealing with traces, the most accurate which we could wish to have.

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7944. Better than the Reinsch test?—Yes, much better. The Reinsch test first requires a large quantity of beer, and is not so sensitive. In the second place it is not applicable to certain ingredients. For instance, when we have to deal with the cane sugar or a product of the inversion of cane sugar containing levulose, that, under the influence of the large amount of acid used in the Reinsch test, carbonises, deposits a large quantity of humus matter, which prevents the copper from attacking the arsenic. In fact, an arsenical sugar gives no Reinsch reaction.

7945. Have you tried the Bloxham electrolytic method?—No.

7945. Have you any opinion to express regarding it?—No.

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7947. (Sir William Church.) Have you examined any foreign beers?—Yes, a few.

7948. Were they entirely free from arsenic?—Yes, entirely. I sent for some bottled beer, and I obtained some quite free, which gave no reactions under the conditions where I got a reaction in English beer.

7949. You do not, of course, know how the malt was prepared that the beer was brewed from?—No, and my experience with foreign beer is quite small.

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of coal.

7950. You have in your mind some way in which you think the whole of the arsenic might be retained in the ashes of the coke?—Experiments are being made at present with a process based on the same principle as that which was in use a good many years ago, to retain sulphur in coal and coke, which depended on the liberal addition of lime to the coal, which fixed all the sulphur, and I believe retains much of the arsenic. Whether it will do so fully I cannot say yet.

7951. That is not likely to be a process which would give off fumes which might be found prejudicial from a commercial point of view to the malt?—I should think not. I should think it would retain the sulphur and possibly other acid products of oxidation. But I think a considerable amount of the arsenic in malt is due to the coal ashes which fly up, and that seems proved by the fact that if I take a malt and determine the arsenic in it, brushing it well and cleaning it, as a rule the arsenic much diminishes.

7952. That might arise from the deposit of volatilised arsenic upon it?—It might, but when one thinks of the immensely small quantity, especially as the malt at first is moist and arsenic will stick to it, I think it is unlikely.

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7953. The quantities that you found in these other materials, caustic soda, sulphurous acid, and sulphites, and so forth, although you say you are not a doctor, they are really such small amounts that they are quite negligible?—Especially those things like sulphites; no large quantity can be taken. In the case of oxide of iron, which I may find in connection with the colouring of confectionery, the amount of arsenic seemed to me sometimes appalling. A small pen-knife point sample of the substance gave actually innumerable stains by the old Marsh process, not by the Berzelius Marsh modification. I could obtain stains of arsenic from a very tiny quantity of oxide of iron. Knowing that oxide of iron may go into bloater paste, I have obtained a good many samples of bloater paste, but I could not trace any arsenic in them. But I do not think arsenical oxide of iron should be used in food.

7954. That is, used as a colouring material?—Yes.

7955. Do you know if it is used as colouring material in confectionery?—Yes, chocolates.

7956-8. (Professor Thorpe.) Have you had occasion to examine the dust from malt?—Yes, a few.

7959. But only for the arsenic?—Never for anything else but arsenic.

7960. You have not pushed your examination so far as to satisfy yourself it actually was coal ashes?—No. I think such an endeavour would meet with many difficulties because the dust brushed from malt is largely organic matter from the malt itself.

7961. But the determination of the ratio of the silica to the oxide of iron and lime would enable you to know whether it was actually coal dust?—It might. Many of my friends have taken samples of ashes from all parts of the malt houses, and it is plain in places where there can be no malt dust or probably there is none, that the arsenic is always present, and is in the form of coal ashes.

7962. I think the general impression which the Commission has gained from the evidence which has been presented to it is, that the arsenic has been deposited on the malt rather in the form of volatilised arsenious oxide?—That was the early impression we all had, that arsenic volatilised very readily from the coal or coke, and of course it would condense when it came in contact with the moist or cold malt. But since we know, quite contrary to most people's expectation, that most of the arsenic is not volatile at all, I think it alters matters more or less.

7963. If it is in that condition, how would you get it into the mash tun in a soluble condition?—There is undoubtedly some in the soluble condition. I have made experiments on malts. I can wash some arsenic off with water alone, and by washing with water and filtering, I obtain an arsenical reaction. But one obtains a larger quantity if one washes the malt with hydrochloric acid. It is not all in the water-soluble condition.

7964. But the impression which one gains from your evidence would be that if the arsenic be in the coal dust in the form of a presumably basic arsenate of iron, or perhaps arseniate of lime, it would be in an insoluble condition?—Yes, much of it.

7965. The greater portion of it?—That which is in form of ash.

7966. Therefore, when the malt is mashed, by far the larger proportion of the arsenic would remain insoluble?—Of course, we have to deal with such small quantities that it is very difficult to be able to say, because a substance is insoluble, that therefore it would not go into solution; we would call arsenic sulphide insoluble, but we know it is soluble to the extent of, say, one in a million.

7967. The direct determinations you have made of the amount of arsenic in the fuel and the comparative estimations you have made of the amount of arsenic in the ash serve to show it must be in such a condition that it must remain insoluble?—That which is in the ash I believe remains mainly insoluble, but not all the arsenic is insoluble. There is a portion which is actually volatile, and which I believe to be present in the malt in the form of arsenious acid.

7968. What I want to get from you is that the amounts which are present in the malt, especially in those malts which have been treated with dilute acid, as in many cases they have, preparatory to the examination being made, do not really give us any clear idea of the amounts which might go into the beer?—No. If the chemist obtains a sample of malt from a maltster, he determines the total arsenic which he can obtain from it.

7969. You rather led me to believe that at least 9-10ths or some such amount remains insoluble?—No. I hope not; not in the malt. Nine-tenths or thereabouts of the total arsenic in the coal is in the ash. I do not suggest all the ash goes into the malt. On the contrary, no doubt in most cases a fraction, say 1-10th, burns off, and probably is in the malt in the form of arsenious acid.

7970. But the larger proportion is in the form of this basic arseniate of iron or insoluble compound which must be insoluble?—In the coal ash, but not in the malt.

7971. What makes it soluble in the malt?—That insoluble stuff is in the coal ash, and the coal ash would not reach the malt otherwise than as dust, the bulk of the ashes remaining behind in the furnace.

Mr.
O. Hehner
21 May 1901

Volatile
arsenic in
coal.

Solubility of
sulphide of
arsenic.

Mr. O. Hehn. 7972. But such portion as does go still remains insoluble?—I suppose it would.

21 May 1901. 7973. (Chairman.) Have you ever filtered beer before testing it for arsenic?—Never.

Sediment of beer, more arsenical than the liquid. 7974. Have you ever examined the sediment in the bottom of a beer cask or bottle?—Yes; I have examined the sediment, which is mostly yeast, and yeast as a rule is more arsenical than the liquor from which it is deposited. Whether that is a matter of precipitation or the yeast assimilates the arsenic and then concentrates it, I do not know.

7975. Have you found arsenic in the deposit from beer in bottles or cask?—Not in bottles, but in casks.

7976. Can you give any idea of what quantity there may be in the sediment of a cask?—No; I do not know.

7977. In a beer in which there is no arsenic discoverable or only a minute trace, may there be a sediment more contaminated with arsenic?—I am afraid I cannot answer the question generally; I have too little experience to say. But in a few cases I have had sediments from beer where in the sediment the arsenic was easily discoverable, and many other chemists have found that the yeast deposited from the wort is more arsenical than the wort itself. I may say, on the other hand, there is often a disappearance of arsenic. I have had samples of beer in which I have carefully determined the arsenic and re-examined them after some weeks, and the arsenic was completely gone. The same applies to exceedingly dilute standard solutions, and the arsenic can vanish entirely from these.

probably is volatilised. 7978. In that case it must be deposited?—I do not know. I think it is volatilised. It is well known that certain fungoid growths, penicilliums, can volatilise arsenic, giving off arsenical gases, and that might be an explanation why, in samples of beer when they are kept, the arsenic diminishes.

7979. That must be when they are kept open?—Yes, and when they go bad.

7980. If the arsenic volatilises from beer in a cask, do you think it comes out into the air?—I do not know. I have no experience. I suppose it would not change.

7981. Nothing could get out of a corked bottle?—No.

7982. (Professor Thorpe.) These alkaline carbonates you speak of, do you imagine the arsenic you find in them comes from the sulphuric acid which has been indirectly used?—I believe in many cases it does, but in other cases not. I have some evidence in the case of alkali which has not been made with sulphuric acid at all, and where traces of arsenic could be found.

7982*. From the ammonia soda process?—Electrolytic.

7983. Have you found it in ammonia soda?—I do not think so.

in refined sugar. 7984. (Mr. Cosmo Bonsor.) In the refined sugar and molasses where you found the arsenic, have you any idea of the process in which the arsenic got in?—I have no idea. They were a certain kind of German sugars, and most of them were free. I examined a certain sugar product for a large firm, and I found small traces of arsenic, and they, being very careful, submitted every kind of sugar which had gone into their works. They traced it to a particular brand which always contained it, to a particular brand of sugar from a particular refinery, which always contained traces.

7985. (Chairman.) Was that West Indian sugar?—No, German beet.

7986. Have you found arsenic in West Indian sugar?—I have never tested it.

7987. Was your test for arsenic made after the outbreak of this epidemic?—Yes.

7988. You had never tested sugar for arsenic before?—Never.

7989. (Professor Thorpe.) How do you imagine the arsenic gets into sugar?—It is imaginable it came in by the liming of the sugar. In a lime kiln it is likely, I take it, that lime may retain a good deal of the arsenic from the fuel, and it might then come into sugar.

7990. Is it possible it comes in from the char?—I think it is imaginable, but it is not general.

7991. (Dr. Whitelegge.) Have you made any direct experiments on the removal of arsenic by moulds from beer?—I have not made any pure cultures, if you mean that. Of course, it is well known that certain moulds,

penicillium brevicaulis, and so on, do evolve arsenious gas. But I had some strongly arsenical beers in the early stages of this poisoning outbreak, and they diminished in arsenic. I kept a number of samples of less arsenical ones aside, and let them get mouldy, and the arsenic in some of them had vanished entirely.

7992. Have you any figures to show the amount of arsenic removed in that way?—No, I have no figures with me, but the amount in the original beer was something less than 1-30th of a grain in those samples I put aside.

7993. In some instances the whole of that disappeared?—Yes.

7994. (Chairman.) How had it been kept?—They were kept in sample bottles, probably badly stoppered. The beers had gone sour, and were put aside on the shelf.

7995. Glass stoppers?—No, corks. The cork had been pulled out, and no doubt was perforated and damaged.

7996. (Dr. Whitelegge.) Have you formed any opinion as to the state in which arsenic is present in beer?—No, I have made some experiments to see the state in which it might be present. I had some samples of beer which were highly arsenical, and I tried whether any of the arsenic was in a volatile condition, but none of it was volatile. I distilled and examined the distillate. I found no volatile arsenic.

7997. You have not formed any opinion whether it is an organic combination or not?—I have not formed any. I do not see any way of ascertaining it with the small traces with which we have to deal.

7998. Would you say as a chemist it is unlikely it would be an organic combination?—No, I think very likely it is an organic combination.

7999. Would that mean in chemical combination with an organic substance, or simply that the arsenic behaved differently because of the presence of organic matter?—I can imagine that in a liquid like beer, where there is a good deal of fungoid life going on, the arsenic might entirely go into organic combination.

8000. You gave us some suggestions as to the amount of arsenic which might be regarded as negligible in beer and in malt, 1-100th of a grain per gallon and 1-100th of a grain per pound of malt. Have you any similar standard in mind as regards sulphuric acid?—I have made a calculation which I have not in my mind, but when one calculates how much sulphuric acid might be used in the manufacture of glucose, for instance, say 3 or 4 per cent., it may be that sulphuric acid can be strongly arsenical before it could introduce so much arsenic as 1-100th of a grain into a pound of glucose.

8001. And you would make your calculation with this data?—Yes.

8002. Is the Committee of the Society of Chemical Industry a large Committee?—It is a Committee of 7, I think. It is mainly an analytical committee; it is not a committee to lay down limits of standards, which are expected from this Commission.

8003. It is a committee of research?—Yes; to get at the best method of determining arsenic and detecting it in different substances. May I add also at the same time that as far as the Reinsch process is concerned the Reinsch process will not discover arsenic in some organic combinations. Cacodylic acids or cacodylates give no Reinsch reaction, whereas the Marsh process shows them as readily as inorganic arsenic.

8004. Are all the members of the Committee working with the Marsh process?—I do not know. Each works at present on his own lines on samples which are made up by some of us unknown to the others, and even the persons who make them up get them changed by the others, so that we are all at present working on samples of unknown composition. We propose to collect all the data and compare them, and select that process which is giving the most accurate results. I know a good many work with the Marsh process.

8005. These researches will be published in the form of a Report, I suppose?—That is the intention.

8006. May we expect that at an early date?—It depends how long the Commission is sitting.

8007. There is no intention to report early?—No, we intend to report as soon as possible, but the Committee is a committee of busy men, and works very slowly.

8008. You are an analyst under the Sale of Food and Drugs Act for several districts?—Yes.

8009. Do you advise the local authorities in these

Mr. O. Hehn

21 May, 1901

Disappearance of arsenic from arsenical beer.

Question combination of arsenic with organic matter of beer.

Some organic compounds of arsenic would not react to Reinsch, would to Marsh test

Mr. districts as to the steps they ought to take under the
Hehner. Sale of Food and Drugs Act?—Sometimes.

lay 1901 8010. Not in all cases?—You mean in reference to
arsenic in beer?

analyst 8011. Speaking generally, do you advise or do you
not merely deal with the samples they send you?—As a rule,
sarily I deal with samples they send me. I carefully refrain
e as to from giving any advice as to what they ought to do, be-
tion of cause I do not want to pose as a prosecutor, but if they
les directly apply to me, I give them advice.

r F. and 8012. And some do apply to you?—Sometimes.

cts. 8013. Have you received samples, for example, of the
bloater paste of which you told us?—Yes. I advised
them as we were searching for arsenic. Some time
before this outbreak in beer we were examining many
substances for arsenic. There were a number of cases
in the police courts against vendors who sold arsenical
sodium phosphate, and from that I went a little deeper
into the matter and got a large number of drugs col-
lected, and I examined these for arsenic, but I
found nothing so serious as was present in that sample
of sodium phosphate which was the subject of the
police court proceedings.

nic in 8014. How much was there in the sodium phosphate?
m phate. —I do not remember. It was a large quantity; if I
remember right, 1 per cent.

8015. You found arsenic in samples of bloater paste
submitted to you officially?—No. I found arsenic in
samples of oxide of iron which had been sent to me
by clients in the trade for colouring food materials, and
then I stopped that as soon as I could. I advised them
not to use any article of the kind, and wrote to some
of my county authorities about the matter suggesting
that it might be well to look into it.

8016. But the results were negative?—Yes.

8017. Were the results alike negative in the other
samples examined with the same object?—Yes.

8018. You mentioned chocolate and other forms of
confectionery?—I have not had any from my districts
from the police. I have had some from the trade. The
quantities of oxide of iron used are very small.

8019. Are samples of sweets and golden syrups sub-
mitted to you?—Yes.

8020. Do you examine them for artificial glucose?—
Yes. We have examined golden syrups for some years
past for glucose, and there have been very many pro-
secutions for the sale of golden syrup consisting more or
less of glucose, but sweets have practically not been
examined for glucose, because the term "sweets" seems
to be a very indefinite one, and there are practically no
sweets without glucose.

se in 8021. If you find glucose in golden syrup, do you re-
den port it as an adulteration?—Yes, and I have reported it
as an adulteration in jams. I have had some prosecu-
tions lately against vendors of jams using glucose
without acknowledgment.

8022. In any of these cases have you found arsenic?
—Never. I found traces of arsenic in sweets, but
nothing very serious—in cheap sweets.

8023. Have all your authorities sent samples of beer
to you for examination for arsenic?—Yes; all.

8024. Was it the practice prior to the Manchester
outbreak to examine samples of beer for arsenic?—No;
it never entered anybody's mind.

mum 8025. What is the largest amount of arsenic you found
ity of in the beer samples?—1.05 grains per gallon.

stock 8026. How much beer was sent to you as a sample?
—As much as I asked for. If I got too little, I would
ask them to send more; but, as a rule, I got about a
pint.

8027. Did you instruct the officers of the Local Author-
ity as to the amount to be taken as a sample?—No.
If I got too little I would say—you must buy more. I
always do with as little as I can, because the inspector
should purchase samples as much as possible in the ordi-
nary way of family trade.

8028. Are samples of beer still being submitted to
you?—Yes; I have some now.

8029. Do you still find small traces of arsenic?—Al-
most invariably.

8030. But nothing approaching the quantity you gave
me just now?—When I have less than one-hundredth
of a grain per gallon it is my practice to report to my

authorities that it contains, in my opinion, an insignifi-
cant trace.

8031. If it contains, let us say, one-thirtieth of a grain
per gallon?—I would report that it contains an undue
proportion of arsenic.

8032. Would you forward a certificate which could be
made the basis of proceedings, in that case?—I would
now. I did not at first. At first there were many
samples with one-thirtieth of a grain, and when I was
asked I suggested the vendor should be notified. In
fact, the vendors were treated very gingerly at first, as
many of them were quite as innocent as the analysts
themselves. But at a later stage they were warned,
and prosecutions were instituted in some cases.

8033. What is the smallest amount for which prose-
cutions have been instituted in your district?—I don't
know.

8034. Anything less than one-thirtieth of a grain?—
No. I believe there have been some prosecutions in
Nottingham for about .05. In many cases I do not
know when there is a prosecution; but I have given
certificates which could be used for prosecutions. But
one-thirtieth of a grain would be rather rough on the
vendor, I think.

8035. Did all your authorities send samples?—They
have, yes.

8036. Varying very much in number?—Yes.

8037. Varying to an extent that cannot be explained
plainly by the population or any consideration of that
kind?—These matters have got very much better in the
last few years. The Local Government Board have
more sharply looked after counties and districts which
do not work the Sale of Food and Drugs Act. It is
a very different state of things from what it used to be.
There are still a few districts which work reluctantly,
but the bulk of them have vastly improved since the
Committee of the House of Commons some years ago
inquired into the matter.

8038. You mean generally, and not with particular
reference to beer samples?—Generally.

8039. Can you say what action the Local Government
Board took?—The Local Government Board sent a cir-
cular to all authorities, drawing their attention to ar-
ticles which might contain glucose, and, consequently,
arsenic, at an early stage of this outbreak.

8040. That followed the Manchester experience?—
Yes.

8041. But I understood you to refer to something
earlier following on a Committee of the House of Com-
mons?—Yes. The Local Government Board for years
have been in communication with authorities that do
not work the Sale of Food and Drugs Act sufficiently
rigorously, in the opinion of the Local Government
Board. At that time there existed no power to com-
pel them to work, but now under the new Act of 1899
there is a provision which enables the Local Govern-
ment Board or the Board of Agriculture to interfere
and to take samples at the expense of the Local Author-
ities.

8042. In default of the local authority has that been
done?—I have not heard of a case.

8043. (Professor Thorpe.) Lord Kelvin desires me to
ask you a little more about the organic combinations of
arsenic. Have you in your mind anything more clearly
as to the form of organic combination of arsenic?—I
have not. I believe from the fact that arsenic vanishes
from liquid like beer it can only vanish in an organic
form. I have never smelt any arsenical odour even in a
highly arsenicated beer.

8044. Do you mean you have not smelt anything like
diethyl arsine?—No. I have carefully looked out for
that and have never smelt anything, and yet the arsenic
vanishes not only from the beer, but from a very dilute
standard solution when it becomes mouldy. I have
taken the mould out of a standard solution, and can
trace no arsenic in the mould itself.

8045. But in the *penicillium brevicaulis* it was found
that the arsenic was assimilated by the mould?—Yes.
and ordinary yeast does it. But *penicillium brevicaulis*
produces a volatile arsenic compound which yeast, so
far, is not known to do.

8046. Would the common mould, the other *penicil-
lium*, assimilate arsenic like the *brevicaule*?—I do not
know.

Mr.
O. Hehner,
21 May 1901

Arsenic in
beer now
brewed,

and action by
authorities
under F. and
D. Acts.

Position of
Local
Government
Board as to
enforcement
of F. and D.
Acts by local
authorities.

Question of
combination
of arsenic
with organic
matter of
beer.

Mr. O. Hehner. 8047. In beer, bread, potatoes, or anything of that kind it is not *brevicaule*?—No; it is *penicillium glaucum*.

21 May 1901. 8048. In the particular instance you cited where the arsenic disappeared, was there a mould present?—Yes. I have never had any pure culture, and so I have not examined it carefully. On a number of occasions I have had to make standard mirrors for various friends, and, using always the same solution, I noticed that the mirrors were getting feebler and feebler, and on making a fresh solution again, the original mirrors were once more obtained. If I let that solution stand, the arsenic vanished completely from it.

8049. When the arsenic is in the beer, before the mould does its work, do you imagine that the arsenic is in any organic combination?—I should not be surprised if it partly were.

8050. In what form do you imagine it might be?—I do not know. I can hardly give a theory.

8051. But it is not anything analogous to cacodyle or diethyl arsine?—No.

8052. These you tell us would not be recognised by the Reinsch test?—It is not.

8053. These arsenicated beers do give a strong Reinsch reaction?—They do.

8054. Would not that indicate that the arsenic was either in the form of arsenious acid?—Yes. On the other

hand, I have made many comparative experiments between the Reinsch and the Marsh, and I always got a stronger indication with the Marsh than with the Reinsch. Whether that is the fault of the process which does not allow the whole of the arsenic to be deposited, or whether it is due to a portion of arsenic being in a condition that it cannot be deposited on the copper I do not know, but the Marsh process gives a larger yield than the Reinsch process.

8055. In the quantitative estimation of the arsenic do you find it is necessary to break up the organic matter?—No, quite unnecessary. I have made many experiments by adding to beers which were obtained as pure as they could be obtained—in fact, I bought some of these Continental beers about which I was asked, in order to get pure beers—I added arsenic to the beer and recovered it back again by the Marsh process which I use—I got an amount in the shape of a mirror, as if it had been an aqueous solution.

8056. And you think it is not necessary to treat the beer with the drastic method of chlorate of potash and hydrochloric acid?—Not only not necessary, but even dangerous. I know that glass is often contaminated with arsenic, and, therefore, the less drastic the measures are which we have to take, the better.

8057. You mean that the materials used, as well as the glass vessels in which the operation is carried on, may contribute to the amount of arsenic which is found?—They may.

Mr. O. Hehner. 21 May 1

Destructi
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able.

EIGHTEENTH DAY.

WESTMINSTER PALACE HOTEL.

Thursday, 20th June, 1901.

PRESENT:

The Right Hon. Lord KELVIN (*Chairman*).

The Right Hon. Sir WILLIAM HART-DYKE.
Sir WILLIAM CHURCH.
Professor THORPE.

Mr. COSMO BONSOR.
Dr. WHITELEGGE.

Dr. BUCHANAN, *Secretary*.

Mr. CLARE SEWELL READ, called; and Examined.

Mr. C. S. Read. 8058. (*Chairman*.) You were Member of Parliament for Norfolk from 1865 to 1885?—Yes, with the exception of a short period in the year 1880, when I lost my election by one vote, and I was out for a few months.

20 June 1901. 8059. And you took part in the work of the Local Government Board?—I was Parliamentary Secretary to the Local Government Board in 1874 and 1875.

8060. You were Chairman of the Adulteration Committee of the House of Commons in 1875?—Yes.

8061. And you served, I believe, on the Beer Materials Committee?—Yes, for 2½ years, and I attended every sitting of the Committee with the exception of the last two, when they were considering the Majority Report. I heard all the evidence.

8062. You have been engaged in farming for many years?—Sixty years.

8063. You were appointed last April to represent the Central Chamber of Agriculture before this Royal Commission?—Yes, in conjunction with Mr. Henry Stopes.

8064. Have you any scientific knowledge of or practical acquaintance with brewing or malting?—None whatever.

8065. You wish to direct attention to the Minority Report of your Committee on Beer Materials?—I do very respectfully urge you to consider my recommendations, which I think the members of the Commission have had before them.

8066. Are you still of opinion that there are some malt substitutes injurious to health?—I believe so.

8067. Do you believe that they are deleterious to health?—I believe some of them are deleterious to health.

8068. Some are deleterious and some are not?—Some are not.

8069. You believe that some glucoses are not deleterious?—I should think that some of the sugars are not deleterious.

8070. But glucose in particular you think so?—I think from the evidence that we had before the Committee the manufacture of glucose is questionable as to the materials used.

8071. With proper materials, do you consider it would be necessarily deleterious to health?—No, not with proper materials. I think it would be cheating the public, but certainly not injuring their health.

8072. Had the Minority Report of the Beer Materials Committee been acted upon, would that have made any difference in respect to the Manchester poisoning?—I think if that report had been acted upon it is quite possible the Manchester poisoning case might have been averted.

8073. In what respect do you think the contamination by arsenic would have been avoided if that report had been acted upon?—By a proper supervision of the materials of which beer is composed.

8074. With regard to the action of the Excise officials or the authorities at Somerset House, do you consider that that action has been a safeguard to the public

Mr. C. S. R. 20 June
Some ma
substitut
injurious
health.

Mr. health?—A very good safeguard to the revenue, but a very poor safeguard to the public health.

8075. Has it been any safeguard at all to the consumer's interest?—I cannot say it has been, because they were of opinion in the evidence that was given before the Committee that there was nothing deleterious used in the manufacture of beer. Experience has proved the contrary.

8076. Do you consider a court of reference, such as is referred to on page 10 of your report of the Beer Materials Committee, should be speedily established?—I do. It was a recommendation of the Parliamentary Committee on the Adulteration of Food Products, and I quite endorse that recommendation. I think that a court of reference composed of competent experts and sound business men should be established for fixing the standards of purity and deciding other points arising under the Sale of Food and Drugs Act.

8077. You consider that guarantees from growers of barley or other produce are not desirable?—I think it would be perfectly ridiculous on the part of a farmer to give a guarantee about his barley. If I was a maltster I should not give any further guarantee than to say I had used the best fuel, and if I were a hop-grower I should say I had used all good materials in the drying of my hops. I should not say anything else.

8078. What have you to say on the opinions of chemical experts and others, some of whom were appointed on the Committee by the Manchester Central Brewers' Association?—Some of those gentlemen also gave evidence before the Beer Materials Committee, and they convinced the majority of that Committee that no ingredients harmful to health were used in brewing. Now, from this further investigation they seem to believe that almost every ingredient used in brewing is more or less poisonous. It seems to me to be this: that they can prove anything when they like, and they can prove nothing when they desire to do so. The effect upon farmers and others is that, as these continual scientific scares are proved mostly to be wrong, when there is any real sound, scientific discovery they are very slow to believe it. I think that is a very sad thing for us, and for the country generally.

8079. Did the chemical experts suggest it is impossible by analysis to ascertain of what materials beer is composed?—Most of them did, at any rate; one or two on the other side said they could discover any large adulteration, and they could also, they thought, discover adulteration even in small quantity.

8080. Did they think that substitutes used by brewers were harmless?—They did, and the majority of the Committee did.

8081. Have you read the report recently issued by the expert committee of the Manchester Central Brewers' Association?—I have read all that which refers to barley and hops and farming.

8082. Did that expert committee make any statement with reference to beer materials?—I suppose it did, but I have not taken any particular notice of that. I went mainly on what they said about the soils, the manures, and barley. I have the authority of Dr. Voelcker, the chemist of the Royal Agricultural Society, to say there are sundry soils which naturally contain arsenic. With regard to manures, I have never heard any charge brought against superphosphate until quite recently. With the permission of the Commission I should like to read a short extract from a letter I have received from Mr. Tom Brown, the managing director of the West Norfolk Farmers' Manure Company, in which he says that more than forty years ago, when they first began to use sulphuric acid for dissolving bones and coprolites, "boxes of soil were sprinkled with arsenious acid in various quantities, and vegetable seeds sown, in some cases immediately after the dressing of arsenic, in other cases a week or a month or three months after the arsenic was applied. When the seeds were sown immediately after the arsenic was applied, the plants perished, but when the seeds were sown a month or two afterwards the plants grew apparently with no hindrance. The conclusion arrived at was that the arsenic had taken an insoluble form not available to the plant. The plants that grew were removed and treated, some in a green state, others dry, and burnt in a hooded crucible, and in no case was any arsenic detected. Dr. Plowright, of Lynn, and Mr. Hamlet, now the superintendent of the New South Wales chemical laboratory, shared the labour of these experiments with me. I did not think at the time that they were of any public value. They were undertaken

at the suggestion of the chairman of this company, and none of us thought them of sufficient scientific interest to publish them.

8083. (Sir William Hart-Dyke.) What date is that?—That is about forty years ago.

8084. About 1861?—Yes; then he goes on to say, "It would be easy in this neighbourhood to point to a very large acreage where as much as 10cwt. per acre of superphosphate has been applied, to my knowledge, four if not five times during the last ten years. If therefore the arsenic and superphosphate could be absorbed by the potato crop, it would require a very small amount of labour to isolate the arsenic in the tubers grown in such soils. The 'Lancet' commissioner can end the matter in a few hours whenever he pleases by testing vegetable substances grown with superphosphate." It is a very common practice indeed in the Fens where potatoes are grown to apply as much as half a ton of superphosphate per acre.

8085. And sometimes more?—Sometimes one ton.

8086. (Chairman.) One ton to the acre?—One ton to the acre. The potatoes are actually on the manure. I have seen them taken up with portions of the manure adhering to them, and I have never heard of anybody's internal laboratory saying there was arsenic in them. With regard to superphosphate as applied to roots, nine-tenths of the superphosphates used in our county is used for the production of roots. I suppose the arsenic ought first of all to go into the turnip, then through the sheep, then into the barley, and then through certain malting and brewing processes; but I should have thought that the sheep would have been the first animal to take any bad effects from the arsenic. I never heard of it.

8087. Do you know if potatoes or turnips have been ever tested for arsenic?—I do not.

8088. Have you known cattle or sheep affected?—Malt culms. Not from eating malt culms or sproutings. This spring I had some lambs go wrong, ten of them dying, from eating the flower of some thousand-headed kale. I was very desirous of checking the disorder, and I had the greatest difficulty in getting malt culms. However, I got half a ton, and I have not lost a lamb since. The difficulty I experienced in getting these malt culms shows how very generally they are used, and how much they are prized by stock-owners and farmers. I have a letter here from Dr. Stutzer, the Professor of Agricultural Chemistry in the University of Königsberg, and his conclusion is this, "From these figures it would appear that we have to deal with such very minute quantities that there cannot be any question whatever of poisoning the plants through arsenic, and of course there cannot be any question of poisoned malt and beer through the soil, even if it could be proved that plants are entirely insensible to the poisonous action of arsenic, which, however, as we mention above, is not the case." I believe he is a German chemist of very high authority.

8089. Do you think beer ought to come under the operation of the Food and Drugs Act of 1875?—I do. As I was chairman of the Adulteration Committee upon which the Food and Drugs Act was founded, I may say that we wished to bring beer into that Act, but we found we could not do so, as there was no legal definition of what was beer.

8090. (Sir William Hart-Dyke.) As to whether it was food or drink?—No; what it was composed of. The report which I drew up was generally considered to be satisfactory, inasmuch as the public were assured that they were cheated and not poisoned. But it appears, in the case of beer, that they have been both lately.

8091. (Chairman.) Would you propose any official definition of beer?—I would. I would suggest the passing of the Bill which is now before Parliament, and which defines what beer should be. It is said not to be a "Pure Beer Bill." That is quite true, but it is a declaration and a definition of what beer should be, and I think it would be very disrespectful on the part of the promoters of that measure if they had attempted to legislate upon the question of arsenic, or adulteration in beer, when those questions were specially committed to this Commission. I think they were perfectly justified in not

8092. You prepared the report of the Committee on which the Sale of Food and Drugs Act was founded?—

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20 June 1901.

Advocates a definition of beer for purposes of F. and D. Acts.

Mr.
C. S. Reid
20 June 1901

I did, and I was also principally employed with the Local Government solicitors in drawing up that Act. We found it very difficult to define what adulteration should mean, but we said that the "nature, substance, and quality of the article" demanded by the customer should be given, and that I believe has been generally a successful definition of adulteration. I have also had very considerable experience in investigating sewage farming, for I was appointed as a Departmental Committee with Sir Robert Rawlinson, the Chief Inspector of the Local Government Board, to investigate all the systems of sewage in Great Britain and on the Continent. Anyone who knows anything about sewage knows perfectly well that the most filthy substances are used for the purpose of irrigation over the soil, and very frequently over the vegetables, and grass growing, but I never heard of any disaster or poisoning happening to stock eating that grass or from the milk produced.

8093. Do you consider the present Beer Bill or some such measure should be passed?—I respectfully entertain the hope that this Commission will report in favour of some such measure. I have had the opportunity of reading carefully through Mr. Stopes' evidence, and I entirely agree with all that I know in it, and I believe in a great many things he will say which I do not pretend to know.

8094. (Sir William Hart-Dyke.) You have had special experience not only as a farmer but as a barley grower?—I have.

8095. East Anglia is particularly favoured in that regard; the lightness of the soil is in favour of growing what is called a good sample of malting barley?—We consider we can grow the best barley in the world.

Object of
Court of
Reference to
fix standards
of purity for
purposes of
F. and D.
Acts.

8096. You urge that had your Minority Report been acted upon this disaster at Manchester might have been averted. Would that have been through the action of this court of reference composed of competent experts and sound business men fixing standards of purity and deciding other points arising under the Sale of Food and Drugs Act? Do you mean the action of a body acting as a Government Department to deal with these matters, or do you mean a Court for the purpose of fixing standards of purity?—I fancy there should be in addition to the Excise authorities, much more strict supervision of the various articles that are being used in brewing.

8097. I had better read the clause. What you recommend is: "A court of reference composed of competent experts and sound business men, to be established for fixing standards of purity and deciding other points arising under the Food and Drugs Act." Was it in your mind when you drafted this that these competent experts should fix a standard of purity and that some Government Department or other body with statutory powers should enforce that standard?—I think so. But there ought also to be a more diligent supervision of the ingredients used in beer—I should have thought by the Medical Officer of Health or some other officer of the local authority as well.

8098. You think in the first place a standard of purity should be fixed, and then that any Government Department which had statutory powers, such as the Local Government Board or the Inland Revenue, should do their utmost to secure that standard of purity?—That is my idea, and this Committee of Standards of Purity would work entirely in conjunction with the Excise. There can be no doubt that the Excise are very useful, particularly for the purpose of protecting the revenue, and if their attention had been called to poisonous ingredients I have no doubt they would have discovered them. You must remember that previous to the year 1880 there were all sorts of ingredients discovered in beer, but suddenly they disappeared from the list of adulterations discovered by the Excise.

Beer Bill
1901.

8099. Then, when you urge that the Inland Revenue failed as regards this particular instance, you are yet of opinion that if the machinery under which they work were improved and fresh obligations imposed upon them it would be a great security?—I think it would, in conjunction with the local authority.

8100. Would you also suggest an amendment of the Food and Drugs Act if necessary?—I think if the Beer Bill were passed that would do all that I require. It would define what beer is and bring it under the purview of that Act.

8101. You think the Bill now before Parliament would indirectly prove an amendment of the Food and Drugs Act?—It would bring beer under the Act.

8102. You think the barley grower should have a free

hand as regards any guarantee that might be demanded of him when his product goes into the market?—I think it would be absolutely ridiculous to ask a farmer who sold a clean sample of barley to guarantee it.

8103. You think whatever guarantee may be given should be at a later stage in the manufacture of beer?—If there is to be a guarantee it should begin, not with the raw article, but with the manufacture of the article.

8104. With regard to malt culms, as a sheep farmer you have from time to time used malt culms extensively?—Yes, for lambs and calves particularly, and for the purpose of adding a nice flavour to coarse feeding materials. They are very useful.

8105. If there were really any deleterious results would they not be more severely felt in young animals, like lambs and calves?—I should say so, certainly.

8106. A lamb three or four months old would feel more immediately the deleterious effects than an older animal?—I should say so. I have known lambs to eat too much of them, they were so extremely fond of them.

8107. I suppose you have read some of the evidence that has been given before this Commission, especially with regard to the finding of arsenic in malt dust and malt culms?—Yes.

8108. Have you had any practical experience as a maltster?—No.

8109. You are aware that evidence has been given in some cases of a great quantity of arsenic being found in malt dust, the dust which gradually collects in the process of malting in the kiln. This malt dust has never been used for feeding purposes?—Never, but we use it very extensively as a manure. I should think that all the arsenic comes from bad fuel. I know a good many maltsters in Norfolk, and I am sure they use nothing but anthracite coal.

8110. You think the best security would be greater care in the selection of fuel by the maltsters in the future?—I do not like to speak with any authority, but I should think that gas coke had better be prohibited altogether.

8111. From what you have heard?—Yes; from what I have heard, that is my opinion. I think gas coke is very injurious to the men making the malt.

8112. Are you in favour of restricting the use of invert sugar or glucose by brewers?—Not at all, only I think they should let us know they use it.

8113. You prefer the provision in the Bill now before Parliament, which would insure to the consumer a knowledge of what precisely he is drinking, to any attempt to restrict the use of these materials?—I do not say I should not like to do it, but I should certainly not advocate it.

8114. As an agriculturist of 60 years' standing, have you ever had the least suspicion that either through the indirect process of manuring or through the feeding of stock there is any reason to suppose that danger has accrued through the use of malt culms?—No. It is my deliberate opinion that, if there is any arsenic adhering to the malt, with thorough good screening and proper brushing the whole can be taken off.

8115. (Sir William Church.) You say that you are still of opinion that some substitutes are injurious to health, and certain glucoses give rise to deleterious effects: what is your opinion based upon?—Upon evidence that we had before the Committee.

8116. I am afraid I am not so conversant with that evidence as I ought to be. What was the evidence that weighed with you?—The evidence of Dr. Schidrowitz, in which he said, "There are strong grounds for stating that at the present time materials which are possibly of an injurious nature are still employed," and he instances sulphuric acid as largely employed in inverting sugar, and says the use of salicylic acid as a preservative is open to grave objections. Then there were some experiments performed upon cats, and the result of that was that certain glucoses had deleterious effects on the cats.

8117. Your opinion is only formed on what you have heard or read; you have never had yourself reason to think that ill effects followed?—I have drunk some exceedingly bad beer in my time, and I believe a good deal of that was made from substitutes. I never took any harm from drinking malt beer.

8118. By substitutes you mean made from starch or meal rather than malt?—Made from substitutes for malt.

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8119. You are speaking of substitutes as distinct from sugar substitutes?—I had rather class it under all substitutes.

8120. It is rather a strong expression to say you are of opinion they are deleterious if you do not make a distinction between what may be called raw material and manufactured material?—I only give you my opinion. That opinion is based upon the evidence of scientific men, analysts, chemists, and others, given before that Committee.

8121. Did they say that if the substitutes were good of their own nature they were less wholesome?—They said they made it less nutritious certainly. They did not say they were poisonous, and I believe some of them did not think they were deleterious.

8122. You spoke of sulphuric acid being used: was not that rather because of an idea in the public mind that sulphuric acid was actually added to beer?—I should say not; not those who knew anything about it.

8123. The evidence which weighed with you was given with regard to sulphuric acid being used in the preparation of these sugars?—Yes.

8124. On what grounds did that gentleman state that sulphuric acid used in that way was likely to make the beer unwholesome?—He thought that some of it contained arsenic.

8125. He was aware it might contain arsenic. Did he say that if the arsenic was removed the materials made by sulphuric acid would be unwholesome?—I do not know that he was asked that, but I am sure he would have said so if he had been asked.

8126. You cannot tell what he might have said?—I gather from his evidence that he thought sulphuric acid might, and did contain arsenic.

8127. That everybody knows?—And that if that was employed in the inverted sugar it would be very dangerous.

8128. (Chairman.) Was that evidence about arsenic given before the recent scare?—Yes.

8129. (Sir William Church.) With regard to the present Bill for amending the law relating to the manufacture and sale of beer, you regard that rather as a desirable Bill in the interests of the public, but you do not regard that as being a Bill for the safeguarding of every beer made with substitutes?—No, it is not a Pure Beer Bill.

8130. This report expresses your own views of what you think in the interests of the public beer should be, and you give them the opportunity of knowing which sort of beer they are drinking?—Yes.

8131. So that you do not regard this Bill at all as safeguarding the public from the possible contamination of beer made in other ways?—I do not. The Bill will carry out my desire which I have had for the last 25 years, that beer should come under any Act to prevent the adulteration of the food and drink of the people.

8132. (Mr. Cosmoonsor.) Were you one of the Committee that drafted this Beer Bill? Who is responsible for the Bill?—I am not.

8133. Do you happen to know who the authors of it are?—I suppose Sir Outhbert Quilter, and most likely Mr. Chaplin, and those members on the back of the Bill.

8134. You know that the Bill permits a certain addition of sugar after the beer is brewed?—Yes.

8135. Do you think that that should be allowed?—No.

8136. Then you do not approve of the Beer Bill?—I do not approve of Sub-section 1 of Clause 9; with that exception it has my entire approval.

Mr. HENRY STOPES, called; and Examined.

8137. (Chairman.) You are a maltsters' architect and engineer, a member of the Council of the Central and Associated Chamber of Agriculture, a member of the Society of Engineers, and the Chairman of Judges of the Brewers' Exhibition?—Yes. I may say I have acted as Chairman of the latter body from the commencement of the Exhibition.

8138. You are also the author of "Malt and Malting," "Barley and the Beer Duty," and other works?—Yes.

8139. You were appointed in April last with Mr. Clare Sewell Read to represent the Central Chamber of Agriculture before this Royal Commission?—I was unanimously appointed with Mr. Read; there was no difference of opinion.

8140. You have had extensive experience and practice, and previously you had made careful study and observation abroad?—Yes, I have been practising in London for 21 years, and I have travelled somewhat extensively. I went through every country of interest from a beer standpoint in Asia, Africa, and America, and therefore I suppose I have had some extensive experience abroad. My chief study was in points now before the Commission, with respect to agriculture, malting, and brewing.

8141. I believe you invented and designed certain malt kilns?—Yes. The two-floor kiln was devised by me as the outcome of what I observed of drying on the Continent with kilns of similar construction, but differing in the methods of applying the heat, and such kilns have proved very effectual and useful in this country for the last 20 years.

8142. Will you describe that kiln to the Committee?—Practically the principle is that in the construction of a kiln I first make it effective in passing through the grain a sufficient volume of air to remove the moisture, a thing which is essential. Throughout the process of the removal of the moisture air is applied at such temperatures as will best effect the subtle, and I believe at present unknown changes occurring in the grain, which actually amount to the cooking of the grain throughout the process. By the adoption of two floors instead of one, one floor in this country having hitherto been the universal practice, I enabled the air which passed over one layer of malt, and which derived but a very small amount of moisture from such a layer, to go through a second layer of very green or wet malt

under the best possible conditions to remove the moisture and give the necessary heat, and also to give a portion of the empyreumatic products of combustion.

8143. Has the air in that case passed through the fire?—Yes, it is simply the products of combustion which, with the excess of air not used in the process of burning, has passed through the first layer of semi-dried, and ultimately completely dried grain, and then acts on the utterly wet grain, which is placed upon the upper floor.

8144. But you do not protect the malt from exposure to the fumes of the fire?—No, because it is absolutely essential and necessary that the products of combustion should come into contact with the malt. You cannot possibly make malt without such products of combustion coming into direct contact.

8145. German malt is made without the air passing through the fire, but you say it is impossible. The thing you say is impossible is done in Germany?—Because in Germany they have a totally different system of brewing. If you adopt the English system of brewing, that is, the ordinary infusion system of mashing with the high temperature fermentation, which are the two main essentials of the English process of brewing, it is imperative that you have the products of combustion in your malt. If you adopt the low system of fermentation and the decoction system of mashing you are then indifferent to such products of combustion.

8146. We have had evidence before this Commission that hot air which had not passed through the fire gave malt that was fit for brewing in the English system?—I believe only one witness has given such evidence, and although he is a witness I know personally, and for whom I have the highest personal respect, I am absolutely certain he was mistaken. It is impossible to dry malt under the conditions he stated. When we can deal with a positive fact we can disregard opinion.

8147. You mean that in your opinion it is not possible?—Apart from my opinion, we must adhere to the facts. When you load into a kiln a quantity of green malt, which has just finished growing, and is ready for drying, you have in it a large volume of water, which water must be removed, and in order to remove it it is absolutely necessary to have a given volume of air passing through it capable of removing such moisture.

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8148. But that air may be hot air which has not passed through the fire?—That is another question. The point which I understood you were asking me upon was with regard to the evidence of Mr. Earp, who gave evidence of one of his kilns having become blocked up and thus prevented the admission of air, and yet he had made good malt. If you have a plate covering the kiln floor which does not admit any air at all you necessarily have a position in which you cannot dry owing to the want of admission of air.

8149. Then I understand that plenty of hot air through the malt is what is necessary?—No. It has been tried many times. Kilns have been constructed in this country with the view of drying as they do in Germany, where they use only hot air, but up to now no such kiln has ever produced malt which can brew satisfactorily. Therefore I hope I am justified in assuming that it is necessary to have the products of combustion as well as the hot air.

8150. In your opinion?—And as a matter of fact. It is an opinion which is not merely a matter of hearsay or of my own conjecture. It has been proved conclusively. I could tell you if you wished the names of places where kilns have been erected on the German principle where malt has been made, where the maltster who has made it has been unable to sell it, and where the brewer who has also attempted the principle has been unable to brew it. Consequently, I believe I am justified in asserting as a fact and not as an opinion that it is necessary to have the products of combustion in direct contact with the malt in order to ensure malt capable of being used.

8151. Is it the carbonic acid, or the carbonic oxide, or hydrocarbons from the fire that you consider to be necessary in air for properly drying malt?—I regret I have not the necessary chemical knowledge to answer that question as I wish. Of course, it is only a matter of opinion with me, as I have not the necessary knowledge. My opinion is an empirical one based only upon experience. It appears the combination of all three, plus some other thing which we at present know nothing about, is necessary. There are certain changes induced in the internal structure of the barley grain itself or in the starch and the other materials that constitute the barley grain which have never been fully investigated, which I cannot claim to understand, and upon which I greatly regret I cannot give fuller information; but the fact remains that you have to put the barley when in that state under such conditions to get the desired result. Why it is, I cannot tell you.

8152. You have designed and supervised the erection of the largest pneumatic malthouse in Britain?—Yes, and I believe it still remains the largest house. At the time of its erection it was certainly the largest pneumatic malthouse in this country.

8153. That is for spirits and not beer?—It was for a distiller's use. I mention that solely to show that I have some experience of the difference in the use of malts by distillers and the use of malts by brewers. That house is an exceedingly successful one.

8154. I believe that on behalf of British agriculture you have evidence which you think desirable to lay before us?—I wish to direct attention to the fact that arsenic is said to be present in hops, barley, and malt. I believe its presence in malt in very minute traces in almost every case has been proved, but I fail to see that sufficient evidence has yet been produced of the presence of arsenic in barley or in hops.

8155. You say in your *précis* that some soils contain arsenic naturally; has that any effect?—I have been informed by chemists of very high standing in this country that it is a fact that certain soils which contain pyrites do contain arsenic, but of course that is simply a matter upon which I have received information, and of which I have no knowledge. But I have put myself into direct communication with a number of the largest manufacturers of artificial manures in the country, and they are entirely at one in the information they gave me, that in the superphosphates and other manures used by barley growers or hop growers, the proportion of arsenic—assuming that even arsenical sulphuric acid has been used—is exceedingly small, and that that again is reduced by the fact that assuming arsenic to be added to the soil, a very small portion, if any, is picked up by the plant. They are all of the opinion that the amount contained, especially in the seed berry of the barley plant, is utterly negligible.

8156. What have you to say as to the fuel used by maltsters, or for drying hops?—May I say before an-

swering that question that I entirely confirm what Mr. Read said. I heard his evidence. He gave the opinions of two or three important people, and I have ample information to confirm them very fully. With regard to fuel, the amount of arsenic in coal, even if we admit there is arsenic in coal, is exceedingly small. With many oven cokes there is positively none, or it is so exceedingly minute as to be absolutely negligible. I believe charcoal has never been accused of containing arsenic in any form. The only fuel which is under suspicion is gas coke. With reference to that, I may say that, as the outcome of my experience, whenever I have found a maltster employing gas coke I have advised him to discontinue it, for the sole reason that it is an undesirable material to have owing to the effect it has upon the men. The men cannot work in the presence of the fumes arising from gas coke with the same comfort and the same pleasure that they can when a purer material is used.

8157. Would you consider common charcoal to be suitable?—When a man goes to the expense of using charcoal, I certainly consider he ought to be allowed to continue its use without any suggestion of impropriety. There are many good hop growers in Kent who I believe go to undue cost in providing charcoal to dry hops, believing that it is proper fuel, and as a consequence I should think it would be very undesirable to stop such men using it. I know of my own knowledge that a number of men employed in this business make a respectable living in burning the charcoal, and that the good hop growers who use this charcoal do so with the knowledge that it is really more costly than the best anthracite coal. They use it therefore in order to produce the best possible result. They want to grow hops thoroughly well.

8158. What have you to say with regard to the use of sulphur by hop growers or maltsters?—It has been said by one or two witnesses that sulphur is used very largely by hop growers, and that some maltsters use it. I believe that the number of maltsters who employ sulphur in that form, burning it upon the fire with the drying material, is exceedingly limited, and I believe as a matter of fact that the hop growers who use sulphur in that way do so solely with the view to pleasing their best customers—the brewers. The brewers like to have hops presentable to the eye; they like to have them nice in appearance, and the sulphur gives a better green, a nicer, brighter, and more living colour to hops than the hops without the sulphur would have. Consequently it is entirely in deference to the wishes of the brewers that the exceedingly small amounts of sulphur so burned are used by hop growers. That such a combustion of sulphur could add an amount of arsenic in the slightest degree harmful is to my mind simply ridiculous.

8159. In your opinion does any arsenic remain when malt has been thoroughly brushed?—I should say that if an efficient brushing apparatus be employed, unless it can be proved that the arsenic penetrates the skin of the barley grain, it would absolutely remove the whole of the arsenic. Any effective system of brushing would do that. With reference to that matter, I may say that fifteen years ago I put into Messrs. Barclay's experimental brewery an exceedingly severe form of brushing arrangement known as a smutter or wheat scalper, and that machine is running to-day, and I am authorised to say running with great satisfaction, cleaning the malt absolutely efficiently and thoroughly. I am perfectly certain that with the use of that machine, no matter what quantity of arsenic may have been deposited on the skin of the malt prior to its insertion in the machine, it would effectually and efficiently remove it. That is a thing capable of proof.

8160. You say in your *précis* that there are two systems of making malt?—I hope I may be permitted to say what I know with regard to the barley. I am chairman of the barley judges of the Brewers' Exhibition.

8161. That is scarcely a subject for this Commission. This Commission has not to decide with regard to different barleys?—But the farmers feel very grievously that a great deal has been said here with regard to the presence of arsenic in barley, which is extremely detrimental to their interest.

8162. (Mr. Cosmo Benson.) By whom?—A great deal of evidence has been given before this Commission.

8163. (Chairman.) Very little evidence about arsenic in barley has been given before this Commission.

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There has been evidence of arsenic in malt, but the evidence about barley has rather pointed to its not containing arsenic?—If it be accepted that that is the view of the Commission that barley does not contain arsenic, I will gladly pass over the point; but I wish there should be no misunderstanding. There has been, as far as I can remember, reference made that second-rate British barleys could not be used, and that sugar and foreign barleys have to be used in its place, or if sugar be prohibited, then a much larger quantity of foreign barley would be used.

8164. (Sir William Hart-Dyke.) That is apart altogether from the question of arsenic in beer or arsenic reaching the malt through the fumes of the fuel?—I was merely wishing to combat the suggestion that arsenic could be traced back to the barley. If I may take it that is dismissed, I am only too glad.

8165. (Chairman.) In your view arsenic is not found in barley?—I wish to confirm that absolutely. I say it is ridiculous. With reference to arsenic being liable to be present in the different systems of malting, I say there is no difference. So far as the indication of arsenic is concerned, it is just as liable to be introduced by any system of pneumatic malting as by the old-fashioned English system.

8166. You say in your *précis* that the two systems of making malt, by the old-fashioned open floor system, and the several types of pneumatic houses are alike unable to add arsenic to malt?—It is not able to do so—there is no liability.

8167. Do you contest the evidence that has been given that malt is liable to become coated with arsenic through the use of fuel, the fumes of which contain arsenic?—Up to the present the system of drying has been the same for both systems of malting, and the point I wish to make is that there is no difference whatever system of malting be adopted. It is purely a question as to how the fuel is used, and, still more important, as to the character of the fuel employed.

8168. (Mr. Cosmo Bonsor.) The system of malting you are alluding to on the floor is the system of germinating the corn, and whether that is on an open floor or in what is called a pneumatic drum, it is the same thing?—Yes.

8169. The question of the kiln comes later?—Yes.

8170. (Chairman.) I should consider making the malt to include, first, the germination, and, lastly, the drying. But your remark is limited to the first process, that no arsenic gets into the malt in the germination process?—Yes. In my *précis* I say that up to the present the modes of drying are the same for both apparatus.

8171. You go on to say in your *précis* that "air heated only cannot make good malt, as the products of combustion must be in direct contact with the malt when wet. The different flavours of black, brown, and numerous varieties of malt, are alone attained by attention to this law?—That is so.

8172. But in the process of making black malt, is not the final process, giving the distinct flavour, one in which the malt is heated to a high temperature in a cylinder, outside the products of combustion altogether?—That is so, but there again properly made black malt should have been subject to the influence of fuel on an ordinary kiln prior to being placed in the cylinder, because genuine black malt ought to be first of all germinated and dried in the ordinary course prior to submission to the higher heat of the cylinder which will caramelize it.

8173. Whenever malt is used by a brewer, do you think it necessary or a good thing to give it a final brushing prior to screening?—I think it is desirable that maltsters should clean malt efficiently prior to delivering it to a brewery.

8174. A primary brushing?—Yes.

8175. And the brewers should give it secondary brushing?—Yes, wherever a brewer has power it is certainly to his advantage to give it a complete brushing prior to use.

8176. You tell us that the Chambers of Agriculture are quite clear that the liability, should the presence of arsenic be detected in beer, ought, under no circumstances, to be carried back to the grower of hops and barley?—That is so; it is exceedingly unfair to throw the onus and responsibility upon the grower either of barley or of hops, and I believe not only do the

Chambers of Agriculture agree in that view, but almost every farmer and hop grower throughout the country.

8177. But you would agree that the responsibility of arsenic in malt should fall upon our makers of malt?—If they are contributory to the arsenic being present, most certainly.

8178. You have told us that the arsenic does not get into the malt from the barley?—Quite so.

8179. Therefore it can only get in by the process of making the malt; and you think the responsibility of no arsenic in the malt should be on the maltster?—In that case I do not think the maltster should be asked for a guarantee, because if a brewer wishes to buy malt from a maltster, especially with his existing knowledge, he has the power to test such malt. He has no necessity to shield himself from the use of such malt by getting a guarantee from the maltster.

8180. But should not the maltster himself make sure that he gives his malt without arsenic?—In the ordinary course of trading he would do so. Unless he was in a position to know his malt was pure he would not offer it to a brewer. My point is that it is not necessary or desirable that a brewer should insist on getting a guarantee from the maltster.

8181. You mean he must obtain arsenic-free malt from the maltster?—Certainly, and he has the power to secure that.

8182. And that a maltster selling malt to a brewer would imply that it was arsenic-free?—Certainly.

8183. But you would not have him give any guarantee in writing?—No.

8184. You would let it be understood that the maltster gives it arsenic-free, but you would not ask him to give a written guarantee?—Precisely, because the brewer has the power to determine that the malt is arsenic-free prior to purchase.

8185. If the maltster gives him malt containing arsenic, the brewer can find out?—Absolutely.

8186. (Mr. Cosmo Bonsor.) Not prior to purchase?—Certainly.

8187. (Chairman.) Do not you think the maltster himself ought to be held responsible, and not leave it solely to the brewer to find out his fault?—I think that the brewer in the ordinary course of business has ample opportunity to ascertain for himself that the malt he is about to purchase is arsenic-free.

8188. Then you correct the answer you previously gave, and you now say the maltster gives his malt without any guarantee, and tells the brewer, "Remember, I do not guarantee this malt arsenic-free"?—I do not say that. What I think is that he should not be asked to guarantee.

8189. That is to say, the maltster must give it on the condition, "I do not know whether there is arsenic in it or not. I give it to you as I have made it"?—I do not go so far as that.

8190. You would not let it be put in writing, but you would have it understood that was arsenic-free?—The maltster ought to know it was arsenic-free, and he should take every care that it was so.

8191. If he knows it, should he not say so to the brewer?—Certainly, but at the same time I do not think the brewer should go back on the maltster and insist on having a guarantee before purchase, because if anything arises he has the maltster to fall back upon.

8192. However much arsenic there is in the malt, the brewer should understand that the maltster washes his hands of it?—Certainly; he should buy the malt without arsenic. If the maltster does not know his business, and supplies malt with arsenic in it, the brewer, especially after recent occurrences, should be quite sufficiently up in his business to protect himself. What I object to, and what the farmers object to, is that the guarantee should be asked in the form that a number of witnesses appearing before this Commission have demanded, that there should be power to the brewer to fall back on the maltster with his guarantee.

8193. Let us leave the farmer out of it?—Leave both out of it.

8194. But the man who can put arsenic into the malt in the making of it cannot be kept out of it, and it is the first time we have heard it proposed by any responsible person that any kind of food business should be

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conducted on the principle that, "I sell you something which may or may not contain arsenic, which you are to find out—I do not know, and I do not care whether it contains arsenic." That is what I understand you to make the maltster's position?—Put that way, yes, but if I may be permitted—the point may be a very fine one—what I wish to do is this. I stand up in the interests of the maltsters, and I say that they should not tie their hands behind their backs and give guarantees which may some day fall very heavily upon them, because they do not have the final disposition of this malt. If in the course of manufacture, the brewer employs any material which may contain arsenic, and then tries to fall back on the maltster, that guarantee may prove a very awkward thing.

8195. My question did not relate to that, but solely to the malt supplied to the brewer, and your answer is that the maltster gives it to the brewer, and ought not to be asked by the brewer whether it is arsenic-free or not?—No, the brewer should ask, and the brewer should compel the maltster to know, but he should not ask for a guarantee that could exculpate him completely. That is the point.

8196. (Sir William Church.) You confuse two things. You are saying that the brewer should not be exculpated if arsenic is in his beer by having a guarantee from the maltster?—Yes.

8197. No one suggests that. He would have to show that the particular malt was in default, and that his other ingredients were free from arsenic. But why should the maltster be excused from selling a pure article any more than the person selling other beer ingredients?—If it be put that way, I think as practical men that the brewers have the power to protect themselves prior to purchase. It is so simple a matter to test malt for arsenic, and therefore the brewer can protect himself.

8198. (Mr. Cosmo Bonser.) You have been at Mark Lane?—Yes.

8199. And you have seen brewers buy malt there by the samples? How can they test it—by their mouth or eye, or how are they to know that the samples contain arsenic?—Many brewers have now discontinued going to Mark Lane to buy malts.

8200. That is not an answer. I am asking you a question. You know that on Monday brewers go to Mark Lane, and do buy malt. How can they tell when they get a small bag of malt that that malt contains arsenic?—It might interfere with the dealing between maltster and brewer, and hereafter I believe no brewer will go to Mark Lane and buy by samples without investigation unless he is protected by a guarantee.

8201. (Chairman.) He will find out if it is not correct, but he will naturally want a guarantee from the maltster that it is free from arsenic?—The maltster can guarantee that he has used the best fuel he can employ, and I believe that ought to be the extent of his guarantee.

8202. The maltster can guarantee that he has himself tested his own malt?—Certainly.

8203. And would you disapprove of him testing it himself, and guaranteeing that it is free to the brewer?—I should say every maltster should test for himself, but should hesitate to give the guarantee.

8204. Should he tell the brewer he has tested himself, and believes it to be free from arsenic?—In the ordinary course of business if he were offering a sample of malt he would tell the brewer he knew it was arsenic-free, and I believe the transaction could stop there.

8205. (Sir William Hart-Dyke.) With regard to this question of fuel, I believe you urge that the quantity of arsenic in any coal, charcoal, or other fuel, is small. You are not a practical chemist, are you?—No.

8206. You do not test for yourself?—No.

8207. Where do you get this information?—From a variety of sources.

8208. What kind of sources?—Actual analyses by competent men.

8209. You say in your précis that no correct figures have been given in evidence before this Commission with regard to these matters?—As to the proportion of arsenic liable to be present in beer through the use of malt.

8210. Have you any evidence to offer us which would combat what we heard? It is an important statement to make?—It is.

8211. Have you any evidence you could produce before this Commission?—I would direct attention to one paragraph on page 7 of my précis, in which I say, "The assumed quantity of beer made in 1900, calculated at the official standard, was 36,578,000 barrels. But the actual quantity of beer or 'bulk barrels' was 39,473,000 barrels."

8212. That has nothing on earth to do with the question as to whether arsenic is in coke or other fuel. This is a two-fold declaration; in the first place, that very little arsenic is ever found in any variety of fuel; and further that the evidence which has been given is not correct. You say, "It is the same with fuel. The quantity of arsenic in any coal, coke, charcoal, or other fuel is small. No correct figures have yet been given in evidence before the Commission of the quantities of fuel used, and all statements as to amount of malt dried and quantities of malt brewed require correction." That is rather a strong statement if you have absolutely no evidence whatever to bring forward in support of it. Are you aware, for instance, that the Professor of Chemistry in Liverpool, Mr. Campbell Brown, has given evidence of having tested many varieties of fuel, and that in anthracite he has discovered as much as half a grain of arsenic per lb.? That evidence has been given before us, and there is other evidence of the same kind equally strong?—It is exactly that which I wish to answer. I cannot tell you of my own knowledge, as I have not examined the coal, but I have had submitted to me a large number of analyses by competent chemists wherein they have found no such amounts as you mention. In addition to that, in order to confirm what I there say, I wish to draw attention to the fact that the amount of malt dried by fuel has not been yet correctly stated, because there are many instances where maltsters are drying up to 60 quarters per ton of fuel. Ergo, if there be a small quantity of arsenic in the coal to start with, and if that coal be used so efficiently that it dries three times the quantity of malt assumed, certainly there must be a smaller quantity of arsenic carried through to the final product, the beer. I go further, and I say the amount of arsenic capable of being communicated to the beer by such means has not been correctly stated, for the simple reason that you have no statement yet before you which shows correctly and properly the amount of material used by brewers.

8213. I would ask you whether you are not of opinion that as regards malting, if the evidence shows that the only danger arises from the fumes of fuel, great care in regard to the choice of fuel is necessary, whether coke, anthracite, or any other?—That is the statement of one class of fuel which has not been confirmed. It is entirely beyond anything known by any other analysts. We know as a fact that there is a very large quantity of anthracite coal, used through the whole of the eastern and southern counties, and that the malts dried by those fuels have been subjected to the severest tests, and have passed through them without showing the presence of arsenic. Therefore it is fair to assume that that must have been exceptional coal, and as a matter of fact I have no hesitation in saying it is a coal used by no competent maltster.

8214. (Sir William Church.) You are leaving out of consideration another point on which we have a good deal of evidence, and that is, that the malt you allude to has been well screened and brushed?—Not all—I know that of my own knowledge.

8215. But you do not know of your own knowledge, and you can never say that the London and southern brewers use their malt unbrushed and unscreened?—A large number of the southern brewers do use their malt unbrushed, but not unscreened.

8216. Do you mean that they properly screen it?—They screen it to the extent of removing the culms. Malt when it is dried ready for use undergoes one or two rough screenings by the maltster.

8217. I will not go into that. You spoke as if the absence of arsenic from the southern malt must necessarily be due to the absence of arsenic in the fuel used in drying it, but we have a great deal of evidence to show that careful screening, even without polishing or brushing, does a great deal in removing the arsenic which does get upon malt in the process of kilning?—Yes.

8218. I only wished to point out to you that your inferences are incorrect, because you leave out, in assuming it is all due to the purity of the coal, the effect of brushing and screening?—Not so. I believe

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that the brewers of Manchester have been quite as careful to get malt screened in the ordinary sense as any brewer in London or the southern counties. No maltster would dream of selling malt, and using it unless it had been efficiently screened. But that they brush it is another matter.

8219. (Chairman.) Do you know that much of the malt dust is found to contain a great deal of arsenic?—Yes, so it has been stated.

8220. (Sir William Hart-Dyke.) As much as two grains of arsenic per lb. of malt dust has been proved. You referred to one analyst just now; are you aware that no less than four analysts before this Commission have given conclusive evidence of finding arsenic in fuel? It is chiefly gas coke, but also anthracite, and all kinds of fuel used in the malting. The evidence is very conclusive. It is not as you suggest by one, but by four analysts, very high in their profession?—I do not wish to dispute that, except I do say—and I hope I may be permitted to repeat it—that the quantity of arsenic communicable to the malt is less than has been stated to you, and the malt itself is in such a position that it does not carry through the amount stated.

8221. That is no answer to my question. I am examining you upon a statement of yours in evidence as to the quantity of arsenic found in fuel. However, I will not pursue the point any further. I suppose you are of opinion that there are two processes by which with proper care and attention, security for the public may be absolutely provided, a process of cleaning and screening, and very careful attention to the use of fuel?—Quite so.

8222. Would you support that?—Absolutely.

8223. Many witnesses have come to that conclusion, that proper care must be taken in every case?—Undoubtedly, and if a man exercises proper care and caution in buying his coal and cleansing his malt efficiently, I should imagine there is no possibility of arsenical contamination.

8224. Are you aware that one of the largest brewers in Ireland uses malt only?—The largest brewer of all uses nothing but malt, and the next largest uses an exceedingly small quantity of sugar, but I am sorry to say it is used almost exclusively in the pernicious system of priming.

8225. Have you ever attempted to make any estimate in a bad barley growing season in this country, a wet season, for instance, by which you can tell the amount of English and foreign barley respectively the large firms of brewers in this country would use?—I have never known a season in which there has not been a sufficient supply for the largest brewers who pay a good price for the best barleys grown in this country.

8226. Even in a wet season?—The worst season. I have known every season since 1866. I have had to come into direct contact and judge the barleys of the season in a way which I suppose is not quite common, apart from Mr. Read, who has been good enough to act as one of the judges of the malting barleys at the Brewers' Exhibition. I have acted as chairman of that body for nearly 20 years. It has been my special and direct business to inquire most carefully into the actual quantity of the barleys grown season after season, and officially I state emphatically that I have not known any season in the whole of my experience when there has not been grown in this country a good quantity of barley suitable for the best uses of the best brewer. I believe Mr. Read will agree with me.

8227. Then in a bad season you think there is no excuse for any brewer to go to foreign barley to get a good barley?—That is another question. If there is not sufficient, and if it is necessary to import barleys because we have not grown enough, that would be only an ordinary business course. What I complain of is the very large and undue recourse to substitutes for barley made by brewers. They fly to foreign corn not when necessary, but solely with the view to depreciate the price of English grain, which is a totally different matter.

8228. (Professor Thorpe.) Assuming that malt substitutes, glucose and invert, continue to be used, would you extend the same principle that you laid down in the case of the maltster to the maker of those things—would you allow him to sell his product without any guarantee of its purity?—No, because he is conducting a purely chemical process which requires high training as a chemist; he is employing in the necessary process of his manufacture exceedingly dangerous and doubtful

materials, and therefore he is on a totally different plane.

8229. How is he employing exceedingly dangerous and doubtful materials?—I have never heard of invert or glucose being prepared without the use of sulphuric acid, muriatic acid, or other acids. It is one of the simplest and best known things, as I need not say to an experienced chemist like yourself, that these things are more or less dangerous or doubtful.

8230. How are they dangerous or doubtful?—It has been known for a very long period now that it is extremely easy for arsenic to get into their manufacture.

8231. Now when it is proved to you that arsenic is equally easy to get into fuel, what in principle is the difference between one class of manufacture and the other?—There is no difference in principle. If I were a maker of glucose or invert I should say, "Buy my stuff as it stands and test it on its merits; I give no guarantee."

8232. That is exactly the answer I desired you in the first instance to make. You would put the manufacturer of invert and glucose in precisely the same position in respect to the brewer that you put the maltster?—Yes, if they like to take that line. On the other hand, if in order to curry favour and sell their material they are prepared to give a guarantee, let them take the onus of giving that guarantee.

8233. You make that statement to us deliberately in view of the fact that the greater portion of this trouble has arisen through the manufacturers of these materials accidentally putting arsenic into them?—I do not admit it to be an accident.

8234. In view of these circumstances you nevertheless say if you were a manufacturer of invert or glucose you would recognise no obligation on you to furnish such certificates?—And I should think Bostock's are exceedingly comfortable in their minds that they gave no guarantee.

8235. If you were now in the position of a manufacturer would you still say there is no obligation on you to furnish that certificate?—If I were a manufacturer I should want to get out of giving the guarantee.

8236. (Sir William Church.) I should like to ask a question or two with regard to the suitability of English barley. I think you just now said there was no year in which there was not a sufficiency of good English barley produced for brewing purposes if the proper price was formerly given for it?—Yes.

8237. You have rather changed your opinion, have not you, of late years as regards the suitability of English barley for brewing purposes?—What would you call the "late years"?

8238. The last ten or twelve years?—I have been for nearly 20 years urging upon the British farmers the desirability of improving their methods of growth and adapting the material they produce to brewers' needs. Probably 12 or 15 years ago there was not so large a quantity of good barley grown as recently. If you are referring to writings of mine 15 years since you might perhaps legitimately say that I have changed my opinion lately.

8239. In what way have the farmers improved their growths of barley?—In every way. They have given much more attention to the preparation of the soil; have been much more attentive to the quality of the manure; the quantities and the modes of adding the manure to the soil. They have been much more careful in getting the seed sown at an earlier date. Many of them have been urged to sow even winter barley. They have been extremely careful, the majority of them commendably so, to get the best seed possible; instead of sowing tail-corn they have employed expensive barley of a very high class, and have paid more attention to the period of cutting.

8240. What is the result of all that?—That we get a very large quantity of superfine barley which cannot be surpassed and is not equalled by any barleys grown abroad.

8241. In what way is the barley different now from what it was then?—Then they did absolutely the opposite to what I now advise.

8242. What is the chemical condition of the grain which makes it better now than it was before?—I am not prepared to give a chemical opinion as I do not claim to be a chemist, but I am told by chemists that there is the right relation of the nitrogenous and albu

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minoid matters which enables the grain now grown to produce a malt entirely satisfactory to the brewer.

8243. (Sir William Hart Dyke.) Will it keep its colour after 24 hours of rain when it is out? I have been connected with barley growing since I was ten years old as my father was before me, and should know something about barley, and one of the difficulties is to preserve the colour?—If you deal with a man who insists on having a white barley it will not, but if you are dealing with a man who likes to have a mellow and golden barley it will.

8244. Is it a question of climate?—No, it is not.

8245. As a large barley grower, and as I said connected with barley-growing ever since I was a youth, and having carefully watched its growth and studied it, I therefore ask you that practical question. Are the conditions you are describing such as to produce a good sample of barley after 16 or 18 hours rain?—Certainly it will, in a much better form. In the sale of barleys now, by great improvements in manure and if a man insists on having barley which is white, necessarily you cannot get it after 24 hours rain, especially if the barley has been laid or lodged.

8246. (Mr. Cosmo Bonsor.) Or grown?—It will not grow in 24 hours. If, on the other hand, you have the barley standing on proper straw, able to resist the influences of 24 hours rain, which you do not get in Kent, but which good Norfolk men know, it will stand 24 hours rain, and I have known barley growers get high prices for barley that had had 24 hours rain upon it.

8247. (Chairman.) Before being cut?—Yes, just prior to the time of cutting, when the barley is absolutely ripe and fit for the scythe. If there comes a period of 24 hours rain, and especially if the rain be heavy so as to beat the barley into the ground, it discolours it, spoils its appearance, and damages it very seriously.

8248. But it does not injure its quality except in appearance?—It injures its quality in this way, that if it is allowed to lie in the ground and get discoloured and sprout, but otherwise it does not. You can make absolutely as good beer with barley slightly stained with 24 hours rain as from the best barley grown in Kent. Of course, it is preferable not to have it stained if possible. Now, as the outcome of improved cultivation it is possible for barley to resist undue periods of wet in a better way than it did before.

8249. (Sir William Church.) I may take it that you would no longer write, as I think I am correct in believing you did some 12 or 14 years ago, that some proportion of foreign barley in the production of light beers was a practical institution, and that probably the fact of interference with the use of nitrogenous substitutes would be to increase the proportion of foreign barley. You stated that to another Commission?—Yes.

8250. Now, you think the agriculturist has so improved his agriculture that, notwithstanding a cold or wet season, he would still be able to produce malt for a light beer?—I do not think I should go so far as that. I do say unhesitatingly that the amount of barley grown under normal conditions is much larger, but if the condition of the season be adverse I fail to see that there would be the power to produce such barley. If the season was so bad that no barley grew at all it would be ridiculous to contend that the farmer could produce it.

8251. I may take it at all events that you think our barleys now, by great improvements in manure and other ways, are so improved that ordinary English malt does not contain nitrogenous constituents in forms that render fermentation, attenuation, and the final condition of beer unsuitable and defective?—That is so.

8252. You think we have made really so great an improvement in agriculture in these twelve or fourteen years that we have now got to a certain extent a non-nitrogenous barley?—I do not think so. I believe I am in the position to prove it as a fact. I say unhesitatingly, it is so.

8253. If we have, do you not think that we have greatly lowered the value of our barleys as feeding stuffs?—I know nothing of the value of barley as feeding stuffs. We have not lowered its value to the brewer, but the brewer has lowered the value to the farmer.

8254. You do not wish to give me an opinion. Most grains, as far as general feeding purposes are concerned, are valuable for the amount of nitrogenous matter in them?—I have no experience of the feeding value of barleys. My whole attention has been confined to the

brewing value. The brewer has taught the farmer that he requires barley with less nitrogenous matter, and the farmer has adapted his processes to the brewers' need, and produces barley which is less nitrogenous and more acceptable to the brewer, and I hope every brewer in this country will confirm what I say.

8255. I should like to know what you mean by a phrase in your *précis*. You talk about the "vital properties of malt." I do not in the least understand what that means?—It means that you must use malt to make beer, and that you cannot make beer without malt. There is some vital principle in malt which is not distinguishable by the chemist, which makes it imperative that the brewers should use some malt. I may use the wrong word very probably, but what I mean to say is that if you wish to brew beer you must employ some malt. I would argue further, and say that you cannot brew true beer if you employ a substitute for malt.

8256. (Mr. Cosmo Bonsor.) Not necessarily barley malt?—Yes, I have never heard of a single gallon of beer which does not contain some barley malt.

8257. (Sir William Church.) That is a statement of yours?—It is a fact.

8258. Can you give me an idea of what this vital principle is?—No, and no one else can. It is a matter simply provable; produce beer without barley malt, brew me a gallon of beer without any malt or any combination of malt.

8259. There are thousands of gallons of beer produced without any barley at all. It is not the same kind of beer, but beer all the same?—I am speaking of English beer as we know it.

8260. (Professor Thorpe.) This vital principle is not an entity, is it? Is it some quality which is capable of having material value attached to it, or what is this vital principle?—The value attached to it is that that alone enables you to produce beer. I cannot tell you what entity it has. No chemist has ever defined it. But there is a subtle something in barley malt which renders it imperative upon every brewer in Great Britain, if he attempts to brew beer, to use a proportion of malt. I have never heard of a single brewer in this country, with all my rich experience of brewers, attempt to brew beer without malt. I argue from that, that if it be necessary to use some malt, the more you displace that essential the further you drift from the true science of brewing, and the fluid you produce is not beer, and ought not to be so named.

8261. Your statement simply amounts to this, that malt is necessary to the manufacture of beer?—Yes.

8262. And you associate that with some transcendental principle or quality which is not material in the grain?—That is so. Here you have a large body of men with great capital, who are spending a large amount of intelligence in trying to produce beer by every process under the sun, and up to the present they have never succeeded in making beer without malt. Therefore, I say there is a something in malt which is not in anything else, and as a consequence beer ought to be defined as containing that to the maximum extent, and that everything else is made from substitutes which does not contain this essential essence is not fit to be called "beer," and ought not to be permitted to be called "beer."

8263. (Mr. Cosmo Bonsor.) May they be called ales and stout?—No, I think ale and stout with beer should be kept actually to the malt. It might be called aline, beerine, or stoutine, after the style of margarine.

8264. (Chairman.) You say that malt is necessary, but would you admit proportions of glucose and other substitute substances?—I consider that when the public asks for beer it ought to have the product of malt only, without the addition of glucose, sugar, or any other substitute in any form, and that if all these things be added, there ought to be an intimation given to the consumer that it is so, and there ought to be a declaration made that a substitute has been employed, and it is not the genuine product of barley malt. There should be no hesitation or paltering or beating about the bush. That is a plain simple point that ought to be taken into account.

8265. (Sir William Church.) In the *précis* of your evidence in connection with this vital principle of malt (which you have not made any clearer to me than before) you go on to say that beer substitutes do not possess that vital principle, and, therefore, "recourse has necessarily been made to large quantities of powerful

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antiseptics as preservatives in beer." To what do you allude to there?—I am very glad to have the privilege of answering that question, because I take it that that is really the chief point, if there be any value in anything I have said to you, which may be suggestive to you on that subject. In consequence of the poverty of the materials used by brewers, they now employ preservatives of many types, chiefly limes or sulphurs. Bi-sulphite of lime is the one more generally used. Salicylic acid is very largely used, and a number of very powerful antiseptics and preservatives are necessarily used.

8266. Do you mean by very powerful, "very powerful as antiseptic" or in other ways?—As antiseptics.

8267. Therefore it makes very little difference whether you use a very powerful antiseptic in very small quantity or a less powerful one in larger quantities so far as preserving your beer goes?—If you use sound good malt from good sound barley you have no need for preservatives.

8268. We have got beyond the malt. You have mentioned bi-sulphite of lime and salicylic acid; was there any other preservative present to your mind?—I mention a number, and there are many more—salicylic acid, borax, phylax, K.M.S., sulphites, bi-sulphites—they have been all referred to in previous evidence, and they are all used. In my opinion they are all dangerous, and the fact that they have been used has probably led to a number of dangers to the public health. It is harmful to me to have to swallow these things in the beer, and I should say it is harmful to other people. I feel them, and as I am a man of somewhat strong physique, I maintain that weaker organisms would feel them more keenly.

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8269. Can you tell when you have drunk a gallon of beer which contains borax, or drink another gallon which contains salicylic acid, or another gallon which contains bi-sulphite of lime, which you have had?—I should feel very much ashamed of myself if I could not get to that point long before I drank a gallon. If there is bi-sulphite of lime added to beer I can tell you before I drink it by the mere smell, especially if it is added in the dangerous quantities it now is. It is the practice that every barrel that goes out from almost every brewery very nearly a pint is added, and sometimes more, of powerful bi-sulphite of lime.

8270. I find you have entirely changed your opinion also on the matter of antiseptics from what you held at the time you held out views about English barley, because at that time you thought that in adding such preservative agents first were necessary to enable the brewer to use English barley and suit the increasing fastidiousness of the public palate was only the greater advance of scientific knowledge. You did not at that time think they were the least injurious to health?—But since I have learned they are. You are referring to a period of fifteen years ago, and in that time I have heard of a great deal of harm arising.

8271. What evidence have you of any harm having arisen from any of these preservatives in beer?—You have the evidence that a large number of people have died and suffered in Manchester and elsewhere in a way not fully accounted for by arsenic alone.

8272. In what way is that not accounted for by arsenic alone?—I gather that from the reports I have read. Not being a doctor, I am not in a position to tell you in the language I should wish to use.

8273. But you have gathered an entirely erroneous conclusion from what you have read. You have not read carefully enough, or else you would have seen that the only question was the possibility of its being due to alcohol and the possibility of its being due to arsenic?—I cannot put my hand on the name for the moment, but I read a very important article by a doctor in the "Lancet" last week which appeared to confirm my own view. In the evidence which I have attempted to read intelligently for myself and to master, it has seemed to me there has not been any clear tracing back the epidemic to arsenic only. In the "Lancet" of last week there is an article* which combats the point as to whether

the illness is really derivable from the alcohol or from the arsenic, and therefore I am only quoting someone who has a very much better knowledge of the possibilities.

8274. You did not quote. You made a definite statement to me that these antiseptics you know did harm, and I am most anxious to have that evidence?—I should say that my own opinion on the matter is evidence. I hope it will be accepted as such. I do know of my own knowledge that if I drink beer containing these things I suffer. I have not taken arsenic, otherwise I should have been a living or dead instance of its effects.

8275. When you have had an impure beer disagree with you, have you had it analysed to see the amount of antiseptics in it?—No, because no analyst could tell me what are the effects or influences.

8276. You told me just now you could tell the different effects of these different preservatives on yourself?—I can by the influence on myself and the effects on my palate. I believe I am not wrong in assuming that there are a number of things not capable of being determined by analysts which can be told by the palate.

8277. These antiseptics can be easily recovered from the beer, and therefore when you have beer that disagreed with you, had you sent it to an analyst, and he had told you it contained such and such a percentage of bi-sulphite of lime or salicylic acid, you would have had evidence. But the mere statement is worthless?—May I direct your attention to one answer to one question put to Mr. Estcourt, the City Analyst of Manchester? He stated that he was absolutely unaware that brewers used any of these things even up to December last year.

8278. I want evidence of these substances you have mentioned being prejudicial?—Assuming that I had submitted a beer that I thought was prejudicial, which I knew of my own knowledge I dare not drink without getting heartburn and suffering from inconvenience, to Mr. Estcourt, do you think he would have found bi-sulphite of lime present in the beer?

8279. I have not the slightest doubt of it. If you had submitted it to any single chemist, asking him to look for poison, he would have found it. The beers sent to analysts were merely for adulterations, but you thought you were poisoned, and if you had mentioned any poison he would have told you without a shadow of doubt whether it was present?—A great number of men were inquiring very anxiously what was the cause of the deaths in Manchester, and yet the City analyst of Manchester was unaware that the brewers used any of these things. He was employed by brewers, and ought to have had the knowledge.

8280. (Professor Thorpe.) Where is the direct evidence that bi-sulphite of lime is capable of exercising a prejudicial action?—I presume it carries sulphur in some form or other. I have no knowledge, and I ought not to assume to answer your question. I am not at all sure there may be combinations between sulphur and arsenic which give rise to a much more deadly influence than when they are not present.

8281. I am talking about bi-sulphite of lime, not in conjunction with arsenic or anything else, and I ask you where is the evidence that bi-sulphite of lime is of an injurious nature?—There is no evidence, for the simple reason that few people know that brewers use such things.

8282. Bi-sulphite of lime is a thing known for a very long period of time; its therapeutic and physiological action has been studied. Where is the evidence that it is capable of injury?—Where is the evidence that arsenic would injure any beer until last November.

8283. (Chairman.) But you do not need an analyst because you know these different substances yourself?—I feel them.

8284. Which do you consider the worst, salicylic acid, bi-sulphite of lime, or borax?—They are all bad, but of the three probably salicylic acid is the worst, and it is very bad and harmful to have a combination of it in every article of food one takes. I think it is monstrous that we have these things in the form we now do. We get borax on almost every piece of meat and fish we have sent us by the butcher or fishmonger. Almost all the

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H. Stopes
20 June 1901

* Alcohol and arsenic in the Etiology of Alcoholic neuritis. E. Farquhar Buzzard, *Lancet*, June 8, 1901, pp. 1593-5.

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H. Stopes.
20 June 1901.

wines which come to this country are charged with salicylic acid, and we get all these things in our beer. I contend that taking these things into our system is undesirable, and I know the effects on myself are prejudicial. I cannot define it, but I know it.

8285. (Professor Thorpe.) I should just like to positively and directly challenge a statement made as to the widespread use of antiseptics in articles of food. It is not the truth that borax is used practically in all meats and that salicylic acid is to be found practically in almost

all wines and beers. That is not the fact. The exact proportion in which these things do occur has been recently inquired into by a Departmental Committee, and the precise nature of the facts is well established?—Do you say that bi-sulphite of lime is not used by nearly all brewers?

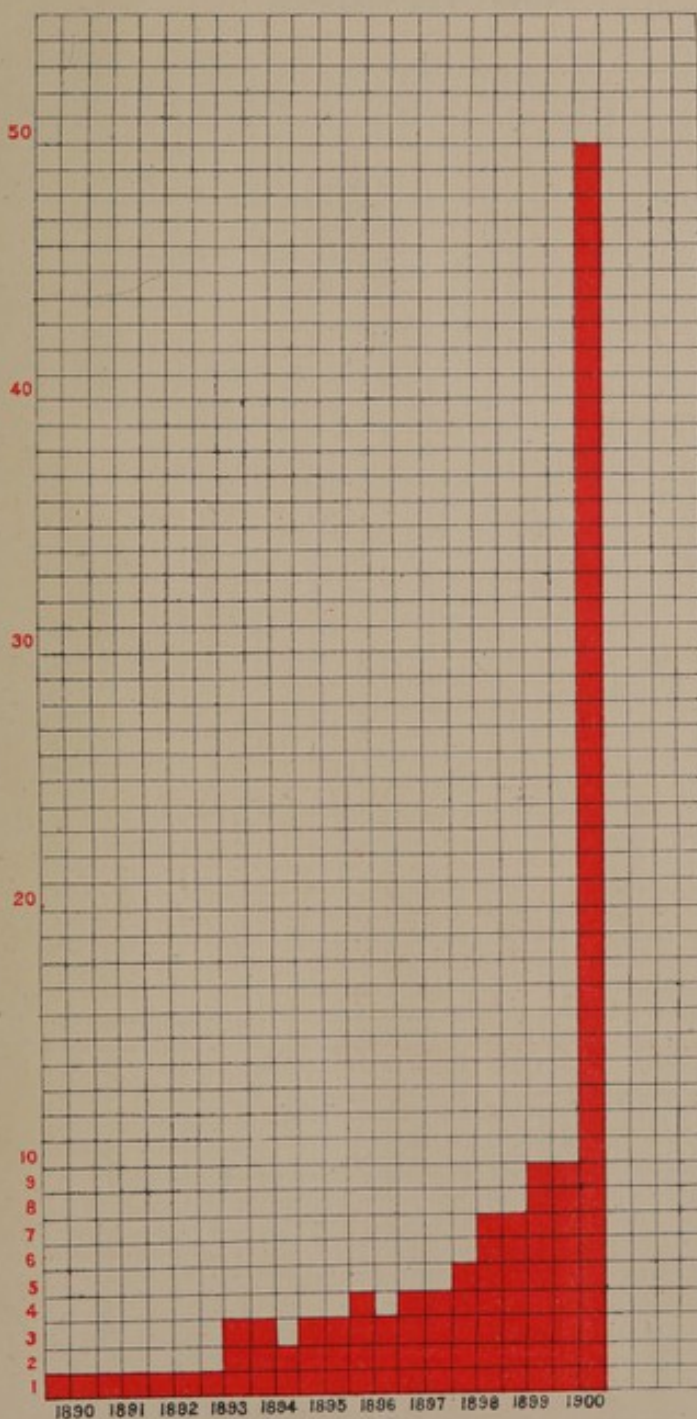
8286. I did not say that?—I contend that bi-sulphite of lime is used by all brewers. That is proveable. The other is only a matter of opinion.

Mr.
H. Stopes.
20 June 1901.

Appendix N^o 1.
CHARTS SUBMITTED BY M^R TATTERSALL.

BOROUGH OF SALFORD.

*Chart showing Deaths from Peripheral Neuritis
each half-year, from 1890 to 1900.*



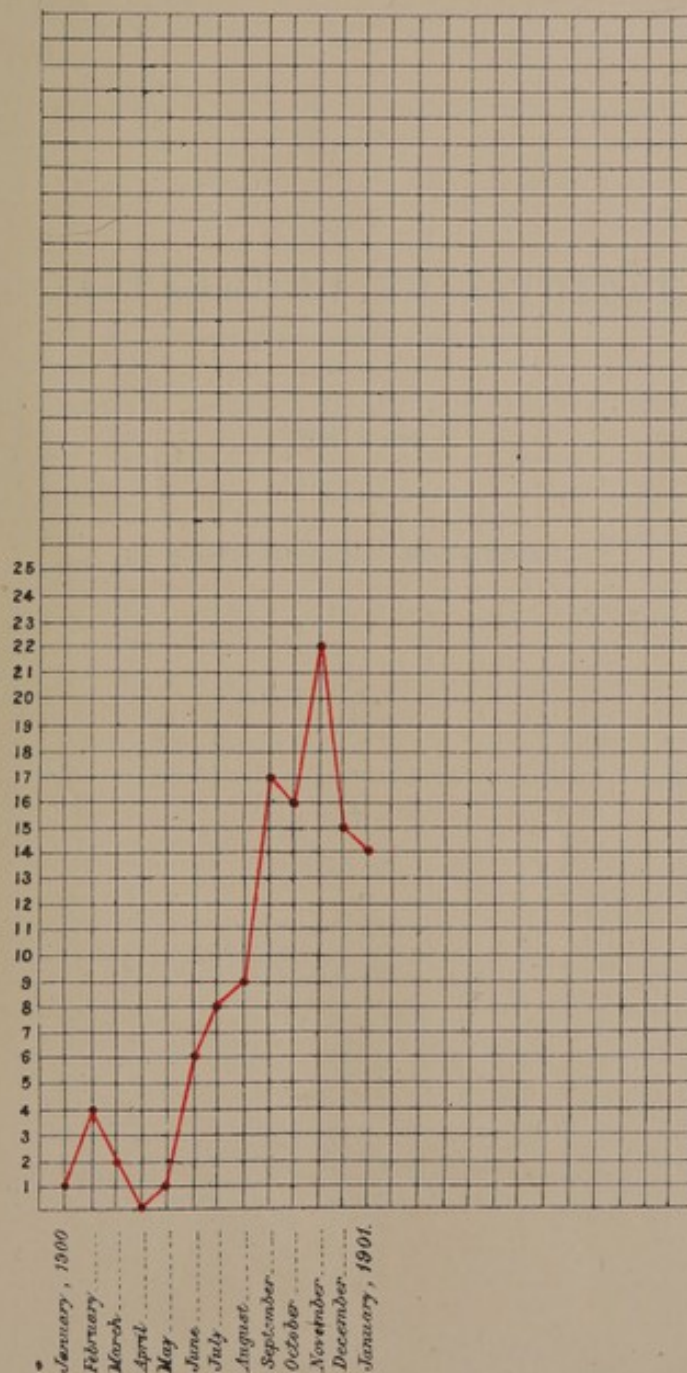
Each square represents one death.

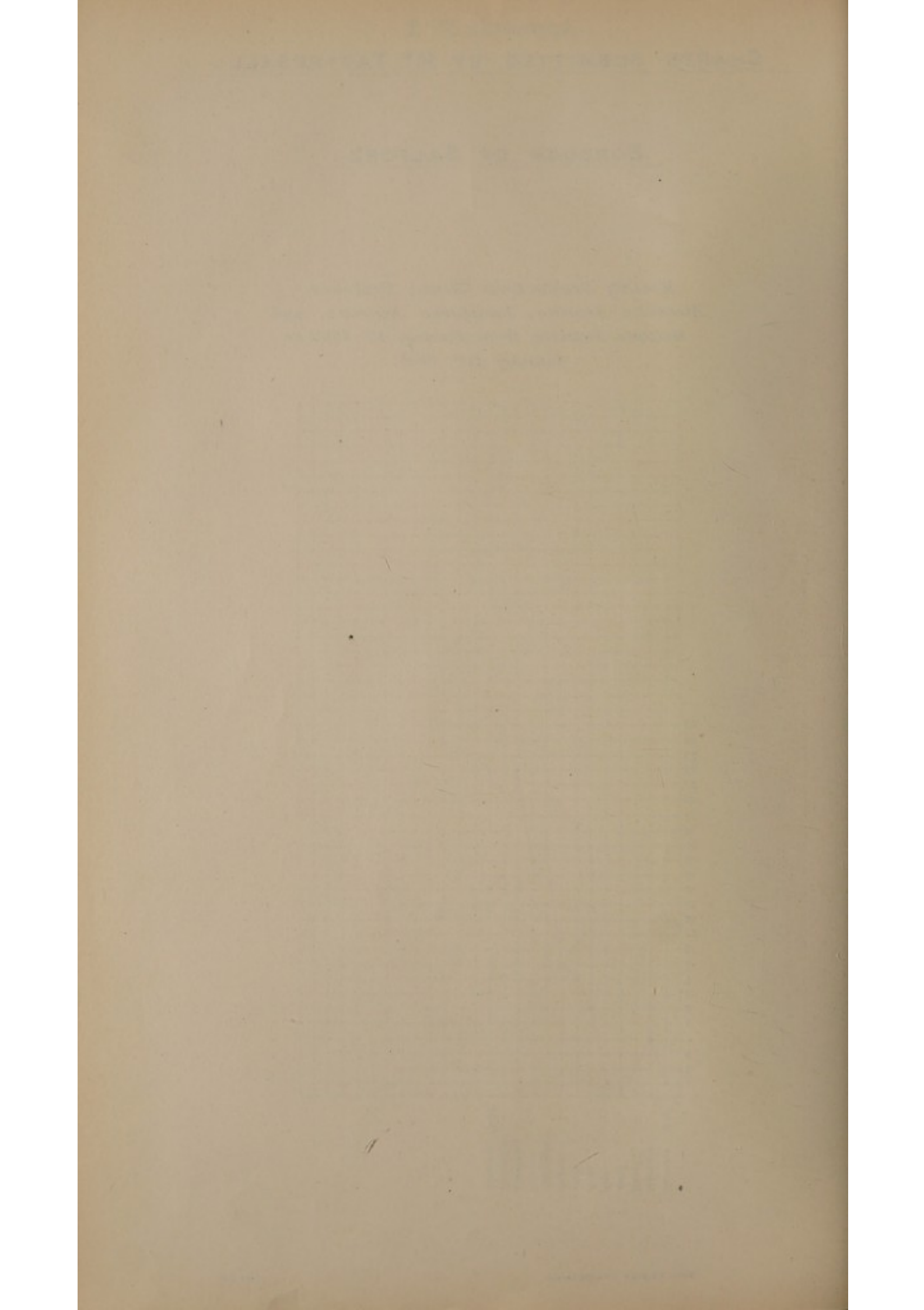


Appendix N^o 2.
CHARTS SUBMITTED BY M^r TATTERSALL.

BOROUGH OF SALFORD.

*Monthly Deaths from Chronic Alcoholism
 Alcoholic Neuritis, Peripheral Neuritis, and
 Multiple Neuritis, from January 1st 1900 to
 January 31st 1901.*





APPENDICES TO EVIDENCE.

Nos. 1 and 2.

CHARTS handed in by Mr TATTERSALL.

APPENDIX No. 3.

Appendix
No. 3.

TABLES handed in by Mr. NIVEN.

A.—DEATHS in Weeks from certain DISEASES

Weeks.	Peripheral Neuritis.					Neuritis.					Alcoholism.					Cirrhosis of		
	1891.	1892.	1893.	1894.	1895.	1891.	1892.	1893.	1894.	1895.	1891.	1892.	1893.	1894.	1895.	1891.	1892.	1893.
1	-	-	-	1	-	-	-	1	1	-	2	1	1	-	1	-	1	-
2	-	-	-	-	-	-	-	-	-	-	1	1	2	1	-	2	1	2
3	-	-	-	-	-	-	-	-	-	-	2	-	-	1	-	-	2	-
4	-	-	-	1	-	-	-	-	-	-	1	-	-	2	1	2	1	1
5	-	-	-	-	-	-	-	-	-	-	1	-	2	1	-	1	1	2
6	-	1	-	-	-	-	-	-	-	-	2	-	1	2	1	1	3	1
7	-	1	1	-	3	-	-	-	-	-	1	2	1	1	-	5	2	1
8	-	-	-	-	-	-	-	-	-	-	1	-	1	1	-	2	1	2
9	-	-	-	-	-	-	-	-	-	-	2	1	-	1	-	3	2	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	2	1	1
11	-	-	-	-	-	-	-	-	-	-	2	-	4	2	1	3	3	2
12	-	-	-	-	-	-	-	-	1	-	3	-	1	4	-	1	1	-
13	-	-	-	-	-	-	-	-	-	-	1	1	2	3	-	4	1	1
14	-	-	1	1	-	-	-	-	-	-	-	-	2	3	1	-	2	1
15	-	-	-	-	-	-	-	-	-	-	1	1	2	1	1	1	2	1
16	1	1	-	-	-	-	-	-	-	-	1	3	1	-	2	1	-	2
17	1	-	-	-	-	-	-	-	-	-	3	1	6	3	-	1	-	-
18	1	-	-	-	-	-	-	-	-	-	3	-	1	2	2	1	2	1
19	1	1	-	-	1	-	-	-	-	-	1	2	1	2	1	-	2	1
20	-	-	-	-	-	1	-	-	-	-	4	-	1	2	2	2	3	1
21	-	-	-	-	-	-	-	-	-	-	2	2	1	1	2	1	6	2
22	-	-	2	-	1	-	-	1	-	-	2	-	2	1	1	3	4	1
23	-	-	-	-	-	-	-	-	-	-	-	1	1	1	-	3	1	3
24	-	-	-	-	1	-	-	-	-	-	-	-	2	-	3	1	1	4
25	-	-	-	1	-	-	-	-	-	-	2	2	3	1	1	1	3	2
26	-	-	1	1	-	-	-	-	-	-	1	3	-	-	2	1	2	3
27	-	1	1	-	-	-	-	-	-	-	2	1	3	-	2	2	2	4
28	-	-	1	-	1	-	-	-	-	-	-	-	1	1	-	-	4	2
29	-	-	-	-	1	-	-	-	-	-	2	1	-	1	4	-	1	1
30	-	-	-	1	-	-	-	-	-	-	3	1	3	1	-	2	-	1
31	-	-	1	-	-	-	-	-	-	-	-	1	5	-	2	-	3	1
32	-	-	-	1	-	1	-	-	-	-	1	1	2	2	1	1	1	1
33	-	-	1	-	-	-	-	2	-	-	2	1	1	2	-	3	4	3
34	1	-	-	-	3	-	-	-	-	1	1	2	1	-	3	1	2	1
35	-	1	1	-	-	-	-	1	-	1	1	1	3	3	1	1	1	3
36	-	-	1	-	-	-	-	-	-	-	2	4	2	1	-	-	2	2
37	-	1	-	-	1	-	-	-	-	-	-	1	1	2	-	1	1	-
38	-	-	-	-	-	-	1	-	-	-	2	1	2	1	3	3	2	3
39	-	-	-	1	-	-	-	-	-	-	2	2	2	3	3	-	2	1
40	-	-	-	1	-	-	-	-	-	-	3	2	1	-	-	2	-	-
41	-	-	-	-	1	-	-	1	-	-	-	1	-	-	1	6	2	3
42	-	-	-	2	-	-	-	-	-	-	1	2	-	-	1	3	1	2
43	-	-	1	-	-	-	-	-	1	-	2	3	1	-	-	1	1	1
44	-	-	-	-	1	1	-	2	-	-	2	1	1	1	3	6	1	-
45	-	-	1	-	-	1	-	-	-	-	-	-	1	2	-	1	3	-
46	-	-	-	1	-	-	-	-	-	-	-	2	1	1	1	-	5	3
47	-	-	-	1	1	-	-	-	-	1	1	1	-	-	-	2	2	1
48	-	1	1	2	-	-	-	1	-	-	2	2	-	2	3	1	2	-
49	-	-	-	-	1	-	-	-	-	1	2	1	3	2	1	1	-	-
50	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	1	2	2
51	1	-	-	-	1	-	-	1	-	1	1	1	3	-	1	2	-	3
52	2	1	-	2	-	-	-	-	-	-	1	1	2	1	1	-	1	3
Total	8	9	14	27	17	4	2	10	3	5	72	56	78	63	55	82	92	76

APPENDIX No. 3.

TABLES handed in by Mr. NIVEN.

Appendix
No. 3.

in MANCHESTER for the FIVE YEARS 1891-95.

Liver.		Liver Disease (other).					Gastritis (Adults).					TOTAL.					Weeks.
1894.	1895.	1891.	1892.	1893.	1894.	1895.	1891.	1892.	1893.	1894.	1895.	1891.	1892.	1893.	1894.	1895.	
3	2	-	-	-	1	1	1	1	1	1	-	3	3	3	7	4	1
-	-	1	1	-	2	-	1	-	1	-	-	5	3	5	3	-	2
1	1	-	-	-	-	1	2	-	-	1	1	4	2	-	3	3	3
1	2	-	1	-	-	-	-	3	1	1	1	3	5	2	5	4	4
1	1	1	1	-	1	2	-	1	1	-	-	3	3	5	3	3	5
-	2	1	-	-	-	1	1	-	-	-	2	5	4	2	2	6	6
2	3	2	1	1	1	1	-	-	-	-	1	8	6	4	4	8	7
3	-	-	-	2	-	1	-	-	-	-	-	3	1	5	4	1	8
1	3	2	1	-	4	-	-	1	1	-	-	7	5	1	6	3	9
-	1	-	-	-	-	1	-	-	2	1	-	2	1	3	2	3	10
3	1	-	-	-	-	-	-	1	1	-	-	6	4	6	5	2	11
2	2	1	1	-	-	2	-	1	-	-	-	5	3	1	7	5	12
1	3	1	-	1	1	-	-	-	-	2	2	6	2	4	7	5	13
1	1	1	-	1	1	1	-	-	-	-	1	1	2	5	6	4	14
-	1	-	-	-	-	1	-	1	-	-	-	2	4	3	1	3	15
2	3	2	-	-	-	1	-	-	-	1	-	5	4	3	3	6	16
1	1	-	-	2	-	-	1	1	1	-	-	6	2	9	4	1	17
1	1	-	2	2	1	1	1	-	-	1	-	6	4	4	5	4	18
1	1	2	-	-	1	1	-	-	1	-	-	4	5	3	4	4	19
3	3	-	2	-	1	-	-	-	1	1	2	7	5	3	7	7	20
-	3	-	-	-	-	-	1	-	-	2	-	4	7	3	-	5	21
1	3	-	2	1	-	-	-	-	-	1	1	5	6	7	3	6	22
-	2	1	3	1	-	-	-	-	1	-	1	4	5	6	1	3	23
-	2	-	4	-	1	2	-	1	-	-	-	1	6	6	1	8	24
3	3	-	-	-	-	-	-	1	1	1	1	3	6	6	6	5	25
-	-	5	-	-	-	1	-	2	1	-	-	7	7	5	1	3	26
-	-	-	-	-	1	2	-	1	-	-	-	4	5	8	1	4	27
1	-	-	-	-	-	1	1	-	-	-	2	1	4	4	2	4	28
4	1	-	3	-	-	-	-	-	1	-	1	2	5	2	5	7	29
3	-	1	1	-	-	-	-	-	-	1	-	6	2	4	6	-	30
2	2	-	3	2	-	2	3	-	1	1	-	3	7	10	3	6	31
-	2	2	-	1	-	-	-	1	1	1	-	5	3	5	4	3	32
3	1	1	1	1	1	1	-	2	-	2	-	8	6	10	6	1	33
2	-	-	1	1	1	2	-	-	-	1	-	3	5	3	4	9	34
1	1	-	1	-	1	1	1	-	1	-	-	3	4	9	5	4	35
1	1	2	-	1	-	-	-	-	-	-	2	4	6	6	2	3	36
1	-	-	1	3	1	1	1	1	-	-	1	2	5	4	4	3	37
1	2	-	-	2	1	1	-	1	-	-	1	5	5	7	3	7	38
2	7	-	-	1	2	1	-	-	1	1	-	2	4	5	9	11	39
1	-	1	1	1	-	-	2	-	1	-	1	8	3	3	2	1	40
-	2	-	5	2	1	-	-	-	-	1	-	6	8	6	2	4	41
1	-	1	-	-	-	-	1	1	2	1	-	6	4	4	4	1	42
3	1	2	-	1	-	-	-	-	-	1	1	5	4	4	5	2	43
-	-	1	-	-	1	2	1	1	-	-	-	11	3	3	2	6	44
2	2	-	1	-	1	2	-	-	2	-	1	2	4	4	5	5	45
2	1	-	-	1	1	-	-	1	-	-	-	-	8	5	5	2	46
1	3	-	1	1	2	2	-	-	-	-	-	3	4	2	4	7	47
1	2	-	1	1	-	2	-	-	-	-	1	3	6	3	5	8	48
1	-	1	1	-	1	2	-	-	-	-	2	4	3	3	4	7	49
-	-	-	-	-	1	1	-	-	2	-	-	1	3	5	1	2	50
2	1	2	1	1	-	-	-	-	-	1	-	6	2	8	3	4	51
2	-	-	2	-	-	1	-	-	-	-	-	3	5	5	5	2	52
68	74	34	43	31	31	41	21	21	27	22	27	221	223	236	204	219	Total.

Appendix
No. 3.

B.—DEATHS in Weeks from certain DISEASES in

Weeks.	Peripheral Neuritis.					Neuritis (other).					Alcoholism.					Cirrhosis of		
	1896.	1897.	1898.	1899.	1900.	1896.	1897.	1898.	1899.	1900.	1896.	1897.	1898.	1899.	1900.	1896.	1897.	1898.
1	-	-	1	-	1	-	-	-	-	-	-	3	-	5	2	1	3	4
2	-	-	1	1	-	-	-	-	1	-	-	-	2	1	-	1	4	-
3	-	-	1	-	-	-	-	-	-	-	1	2	2	2	1	2	1	3
4	-	1	-	2	-	-	-	-	-	-	2	1	3	1	2	1	2	-
5	1	-	-	-	-	-	-	1	-	-	1	-	-	-	1	2	3	3
6	1	-	1	-	-	-	-	1	-	1	2	2	-	2	3	2	2	-
7	1	-	-	-	-	1	-	-	-	-	1	1	-	1	2	2	1	4
8	-	-	1	1	1	-	-	1	1	-	2	1	-	2	-	2	1	2
9	-	-	-	-	1	-	-	-	-	-	-	-	1	1	2	4	2	-
10	-	2	-	-	-	-	-	-	-	1	-	1	-	1	-	1	2	-
11	-	1	1	1	1	-	-	-	-	-	-	1	-	1	-	5	1	4
12	1	1	-	-	-	-	1	-	-	-	1	2	3	3	1	1	1	2
13	-	-	-	-	1	-	-	-	-	-	1	1	-	3	1	3	1	1
14	-	-	-	-	-	-	-	-	-	-	1	2	2	-	1	-	-	1
15	1	-	-	-	-	-	-	-	-	-	3	2	3	2	1	1	1	3
16	-	-	-	-	-	-	-	-	-	-	1	2	-	-	1	1	3	2
17	-	-	-	2	-	-	-	-	-	-	-	2	-	2	2	2	3	2
18	1	-	-	1	-	-	-	-	-	-	4	1	1	1	-	3	2	1
19	-	-	1	-	-	-	-	-	-	1	2	2	2	3	3	-	3	3
20	-	-	-	-	1	-	-	-	-	-	1	2	3	1	2	2	2	1
21	-	-	-	-	-	-	-	-	-	1	1	1	-	3	2	1	1	-
22	1	-	-	-	1	-	-	-	-	-	-	-	-	1	2	-	1	3
23	-	-	-	1	2	-	-	-	-	-	2	1	-	2	2	2	-	1
24	-	-	-	-	-	-	-	-	-	-	2	3	1	-	6	1	1	1
25	-	1	-	-	1	-	-	-	-	-	1	3	1	1	4	-	1	2
26	-	-	-	-	1	-	-	-	-	1	2	2	1	2	2	1	2	-
27	-	-	-	1	1	-	-	-	-	-	2	5	-	2	3	2	3	-
28	-	-	-	-	-	-	-	-	1	-	1	2	1	3	3	-	1	1
29	-	2	-	1	1	1	-	1	-	-	2	-	4	5	2	-	1	-
30	1	-	1	-	-	-	-	-	-	-	1	2	1	2	3	1	1	1
31	-	-	-	-	1	-	-	-	-	1	2	2	1	-	4	2	4	-
32	-	-	-	1	1	-	-	-	-	-	-	1	2	2	1	1	1	2
33	-	-	-	-	1	-	-	-	-	-	-	3	1	-	2	1	3	1
34	-	1	-	-	-	-	-	-	-	-	2	1	-	-	1	1	1	1
35	-	-	-	1	-	-	-	-	-	-	-	1	1	3	1	1	2	-
36	-	-	1	1	1	1	-	-	-	1	1	-	1	1	4	2	2	3
37	-	-	2	-	1	-	-	-	-	-	-	1	-	-	-	3	1	-
38	1	-	-	-	-	-	-	1	-	-	-	2	-	1	4	1	3	1
39	-	-	-	1	-	-	-	-	-	-	2	-	2	4	5	-	3	2
40	-	-	2	2	2	-	-	-	1	1	2	-	-	2	1	-	6	2
41	-	-	1	-	3	-	-	-	-	2	1	1	1	3	4	1	1	5
42	-	-	-	-	2	-	-	-	-	-	1	2	1	2	-	1	2	2
43	-	-	1	-	3	-	-	-	1	-	1	1	1	3	3	2	3	1
44	-	-	-	-	1	-	1	-	-	-	2	2	-	2	5	3	-	3
45	-	1	1	1	1	-	-	-	-	1	1	2	-	1	3	2	2	3
46	-	-	1	-	3	1	-	-	-	-	1	2	1	-	2	1	1	2
47	-	1	-	-	-	-	-	-	-	-	2	2	-	-	1	1	2	1
48	-	-	-	-	6	-	-	-	-	-	-	-	-	-	3	1	1	2
49	2	1	1	-	1	-	1	-	-	-	2	1	2	-	3	2	1	3
50	1	-	-	-	1	-	-	-	-	1	2	1	2	-	3	1	-	4
51	1	1	1	2	5	-	-	-	-	-	1	1	-	-	2	-	2	3
52	1	-	-	-	2	-	1	-	-	-	4	-	1	4	3	-	-	2
	14	13	19	20	48	4	4	5	5	12	64	74	48	81	109	71	91	88

MANCHESTER for the FIVE YEARS 1896-1900.

Appendix
No. 3.

Liver.		Liver Disease (other).					Gastritis (in Adults)					TOTAL.					Weeks.
1896.	1897.	1898.	1899.	1900.	1896.	1897.	1898.	1899.	1900.	1896.	1897.	1898.	1899.	1900.			
3	-	-	3	2	-	-	-	1	1	-	1	1	10	8	8	4	1
-	1	-	1	-	-	1	-	1	-	-	1	-	3	3	2	2	2
-	1	1	1	-	-	1	-	1	2	-	4	-	8	2	3	3	3
1	-	1	1	-	1	-	-	-	2	-	4	5	5	5	2	4	4
4	1	1	1	-	-	-	-	-	-	-	5	4	4	4	2	5	5
-	2	-	1	2	-	-	-	-	1	-	5	5	5	2	6	6	6
2	3	-	-	-	-	1	-	-	-	1	5	2	4	4	6	7	7
-	2	-	1	-	-	1	1	-	1	-	5	3	5	4	4	8	8
1	1	1	-	-	2	-	-	-	-	1	5	2	1	4	5	9	9
-	5	-	-	1	2	-	-	-	3	-	1	5	4	3	6	10	10
1	3	1	2	-	1	1	-	-	2	-	6	5	7	4	5	11	11
3	4	-	-	-	-	-	-	-	-	-	3	5	5	6	5	12	12
-	2	-	1	1	-	-	1	-	-	1	5	3	2	3	5	13	13
1	-	1	1	-	-	-	-	-	-	1	2	3	3	1	2	14	14
3	2	-	1	2	1	-	1	-	-	-	6	4	8	6	3	15	15
2	1	1	-	-	-	-	-	1	-	1	3	6	2	3	2	16	16
-	3	1	1	-	1	-	-	2	-	-	3	8	2	5	5	17	17
3	2	-	1	3	1	1	-	1	2	-	8	5	7	6	5	18	18
1	1	-	-	-	-	-	-	1	-	1	2	6	6	5	5	19	19
-	1	-	4	1	1	-	1	-	2	-	4	8	7	2	5	20	20
3	4	-	-	-	-	2	1	-	1	-	3	2	1	6	10	21	21
2	4	-	-	1	-	-	-	2	-	-	1	1	3	4	3	8	22
-	2	2	1	-	-	2	1	1	-	-	7	3	1	3	8	23	23
4	2	-	-	1	1	1	1	-	-	1	4	4	3	5	10	24	24
1	2	1	1	-	-	-	1	-	2	-	3	6	5	2	8	25	25
5	2	1	2	-	-	-	-	2	-	1	4	8	1	8	6	26	26
1	4	-	-	-	-	-	1	-	-	-	5	8	-	4	8	27	27
4	5	1	-	1	1	1	1	-	-	-	3	3	3	9	9	28	28
4	1	-	-	-	-	1	2	1	-	-	5	4	5	10	5	29	29
3	-	2	-	1	-	-	-	1	-	-	-	4	4	5	3	30	30
5	4	-	1	1	-	2	1	1	-	-	5	8	2	6	12	31	31
4	3	1	-	-	-	-	-	-	-	-	2	2	4	7	5	32	32
4	1	4	1	1	1	1	-	1	-	-	5	8	3	5	5	33	33
1	2	-	-	-	1	-	1	2	1	-	4	5	2	2	3	34	34
5	1	1	-	-	-	-	-	-	-	1	2	3	1	10	4	35	35
-	1	2	-	-	-	-	-	-	1	-	6	2	6	2	8	36	36
-	3	-	-	2	-	-	1	1	3	-	4	3	7	-	4	37	37
1	3	-	1	1	1	2	-	1	1	-	2	7	4	3	11	38	38
1	2	-	1	1	-	-	1	-	1	-	3	4	6	6	8	39	39
1	2	-	2	1	-	-	-	-	1	-	2	8	6	6	7	40	40
-	3	1	-	-	-	-	-	-	-	1	3	2	7	4	12	41	41
1	2	1	1	-	-	-	2	-	3	-	5	5	6	3	4	42	42
4	1	-	2	1	1	-	2	-	1	-	5	6	5	9	7	43	43
1	3	2	-	2	-	-	-	-	-	-	7	3	5	3	9	44	44
2	4	2	1	1	-	1	-	-	-	1	5	6	5	5	10	45	45
2	2	1	-	3	-	-	1	2	-	1	5	5	7	2	8	46	46
2	3	-	-	1	-	-	1	1	-	1	4	7	2	3	4	47	47
2	4	-	1	1	1	1	-	1	1	-	1	3	4	3	14	48	48
-	3	-	1	-	-	2	2	1	-	-	8	6	6	-	9	49	49
1	4	-	-	-	-	2	2	-	-	1	6	1	6	1	12	50	50
-	6	-	-	-	-	-	-	2	-	2	2	6	4	6	13	51	51
2	8	-	-	-	1	-	-	-	-	1	5	1	3	7	14	52	52
93	125	30	36	32	18	24	26	28	32	11	21	200	246	224	228	340	TOTAL.

Appendix
No. 4.

APPENDIX No. 4.

PAPERS handed in by Mr. NIVEN.

TABLE C.—MANCHESTER.

DEATHS from Peripheral Neuritis in Sex and Age Groups.

Year.	Under 20 Years.		20-25.		25-35.		35-45.		45-55.		55-65.		65 Years and upwards.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
1891 . .	-	-	-	-	-	2	1	3	-	1	-	1	-	-
1892 . .	-	-	-	1	-	2	1	3	-	-	-	1	1	-
1893 . .	-	-	-	-	-	2	2	5	-	1	1	1	1	1
1894 . .	-	-	-	-	-	3	1	9	1	2	1	-	-	-
1895 . .	-	-	-	-	-	-	1	8	3	1	-	2	2	-
1896 . .	-	-	1	-	-	1	-	2	1	7	-	2	-	-
1897 . .	-	-	-	-	1	1	-	2	1	6	-	2	-	-
1898 . .	-	-	-	-	-	3	2	5	1	6	-	2	-	-
1899 . .	1	-	-	-	2	1	4	3	3	4	-	2	-	-
1900 . .	-	-	-	1	1	5	4	13	4	10	4	5	1	-
Total .	1	-	1	2	4	20	16	53	14	38	6	18	5	1

DEATHS from Neuritis (other) in Sex and Age Groups.

Year.	Under 20 Years.		20-25.		25-35.		35-45.		45-55.		55-65.		65 Years and upwards.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
1891 . .	-	-	-	-	-	-	1	1	-	1	-	1	-	-
1892 . .	-	-	-	-	-	-	-	1	-	1	-	-	-	-
1893 . .	-	-	-	-	-	-	3	1	1	1	-	3	-	1
1894 . .	-	-	-	-	1	1	-	1	-	-	-	-	-	-
1895 . .	-	-	-	-	1	1	-	3	-	-	-	-	-	-
1896 . .	-	-	-	1	-	1	-	-	-	1	1	-	-	-
1897 . .	-	-	-	-	-	-	-	1	-	2	-	-	-	1
1898 . .	-	-	-	-	-	2	-	1	1	1	-	-	-	-
1899 . .	-	-	-	-	-	-	-	3	-	-	-	2	-	-
1900 . .	-	-	-	-	-	1	2	2	2	3	1	1	-	-
Total .	-	-	-	1	2	6	6	14	4	10	2	7	-	2

TABLE D.

Appendix
No. 4.

HANDED in by Mr. Niven, Manchester.

MANCHESTER.—Deaths from PERIPHERAL NEURITIS and ARSENICAL POISONING from November 25th, 1900, to February 19th, 1901.

Date of Death.	Initials.	Sex.	Age.	Occupation.	Certified or Inquest.	Medical Officer's Classification Cause of Death.	Hospital (which).
1900. 26 Nov.	J. A.	M.	55 years	French polisher	Certified	Peripheral neuritis, phrenic paralysis.	—
30 "	W. H. H.	M.	43 "	Sick visitor for provident society.	Certified	Cirrhosis of liver, peripheral neuritis.	—
29 "	J. F.	M.	70 "	Fustian cutter (retired)	Certified	Senile decay, peripheral neuritis, hemiplegia.	—
25 "	M. E. P.	F.	44 "	Wife of warehouse porter.	Certified	Peripheral neuritis, 21 days; cerebral hæmorrhage, 5 hours.	—
25 "	G. R.	M.	58 "	Formerly a warehouseman.	Certified	Ch. peripheral neuritis, 1 year; dementia.	—
25 "	M. L.	F.	56 "	Wife of a joiner	Certified	Ch. peripheral neuritis, 1 year; dementia.	—
1 Dec.	W. B.	M.	56 "	Warehouse porter	Certified	Peripheral neuritis, 5 months; asthenia.	—
6 "	F. R.	F.	47 "	Wife of concreter	Inquest	She died from arsenic poisoning, no evidence to show how caused.	—
11 "	A. O.	F.	49 "	Wife of wood pattern maker.	Certified	Peripheral neuritis, cardiac failure.	—
10 "	E. H.	F.	50 "	Widow of bricksetter	Inquest	She died from bronchitis and alcohol, and arsenical poisoning.	Crumpeall Workhouse.
10 "	J. D.	F.	45 "	Widow of fitter	Inquest	She died from alcohol and arsenical poisoning.	Crumpeall Workhouse.
17 "	W. S.	M.	48 "	Billiard marker	Certified	Peripheral neuritis, exhaustion	Ancoats Hospital.
20 "	S. J. K.	F.	48 "	Property repairer	Certified	Peripheral neuritis, mitral regurgitation, hypostatic pneumonia, cardiac failure.	—
20 "	A. G.	F.	59 "	Wife of trunk maker	Inquest	She died from pneumonia, hastened by arsenical poisoning.	—
14 "	J. B.	M.	51 "	Hawker	Inquest	He died from peripheral neuritis from arsenic poisoning.	Crumpeall Workhouse.
16 "	A. S.	F.	32 "	Wife of labourer	Certified	Peripheral neuritis, phthisis, exhaustion.	Crumpeall Workhouse.
18 "	E. A. C.	F.	47 "	Wife of hardware salesman.	Certified	Peripheral neuritis	Prestwich Workhouse.
22 "	M. J. C.	F.	46 "	Wife of labourer	Inquest	She died from cardiac syncope, due to peripheral neuritis from arsenic poisoning.	—
22 "	M. T.	F.	49 "	Widow of engraver	Inquest	She died from tubercular disease, accelerated by arsenical and alcoholic poisoning.	—
23 "	J. A. S.	F.	44 "	Wife of painter	Inquest	She died from chronic arsenic poisoning.	—
25 "	M. G.	F.	50 "	Widow of porter	Inquest	She died from pneumonia resulting from peripheral neuritis.	—
25 "	J. C.	M.	34 "	Tinplate worker	Inquest	He died from cirrhosis of the liver, accelerated by arsenical poisoning.	Crumpeall Workhouse.
1901. 2 Jan.	E. I.	F.	62 "	Wife of saw maker	Inquest	She died from peripheral neuritis due to arsenic poisoning.	—
2 Jan.	C. N.	F.	54 "	Unknown	Inquest	Heart failure produced by alcoholic peripheral neuritis.	—
1900. 30 Dec.	M. N.	F.	38 "	Wife of labourer	Inquest	She died from paralysis of the diaphragm due to arsenical poisoning.	Crumpeall Workhouse.
1901. 1 Jan.	M. L.	F.	59 "	Wife of clog iron maker	Inquest	She died from cardiac failure due to alcohol and accelerated by arsenical poisoning.	Crumpeall Workhouse.

TABLE D.—MANCHESTER.—Deaths from Peripheral Neuritis and Arsenical Poisoning, &c.—*continued*.Appendix
No. 4.

Date of Death.	Initials.	Sex.	Age.	Occupation.	Certified or Inquest.	Medical Officer's Classification Cause of Death.	Hospital (which).
1901. 2 Jan. -	J. M. -	M.	40 years	A tin-whistle player -	Inquest	He died from peripheral neuritis due to chronic arsenical poisoning.	Crumpsall Workhouse.
1900. 30 Dec. -	M. M. -	F.	55 "	Wife of painter -	Inquest	She died from heart disease accelerated by arsenic poisoning.	Crumpsall Workhouse.
1901. 8 Jan. -	J. C. -	M.	40 "	Street pavior -	Certified	Peripheral neuritis mitral regurgitation Hæmatæmesis.	—
5 " -	A. H. -	M.	31 "	Beer retailer -	Certified	Phthisis, peripheral neuritis -	—
7 " -	L. B. -	F.	41 "	Wife of painter -	Inquest	She died from pneumonia due to paralysis of the diaphragm from arsenical poisoning.	Royal Infirmary.
6 " -	E. D. -	F.	41 "	Widow of furniture remover.	Inquest	She died from meningitis due to peripheral neuritis from alcoholic poisoning.	—
1900. 2 Dec. -	A. R. -	F.	38 "	Wife of ——— -	Inquest	She died from cardiac syncope due to arsenic poisoning.	—
1901. 10 Jan. -	J. W. -	M.	47 "	Army pensioner -	Certified	Alcoholism, peripheral neuritis (? Beer), exhaustion.	—
7 " -	E. J. -	F.	29 "	Wife of theatrical manager.	Certified	Alcoholic neuritis, six months; coma, two days.	—
13 " -	P. M. -	M.	51 "	Market porter -	Inquest	He died from phthisis accelerated by arsenical poisoning.	Crumpsall Workhouse.
1900. 19 Dec. -	T. B. -	F.	42 "	Wife of hawker -	Inquest	Heart failure following pneumonia, the result of Ch. alcoholism and arsenical poisoning.	Wilkinson Workhouse.
1901. 20 Jan. -	W. S. -	M.	43 "	Plumber and gasfitter -	Inquest	He died from arsenic poisoning	—
15 " -	E. K. -	F.	43 "	Widow of hawker -	Inquest	She died from cardiac failure due to liver disease and arsenical poisoning.	Crumpsall Workhouse.
1900. 23 Nov. -	M. M. -	F.	48 "	Widow of labourer -	Inquest	She died from arsenical neuritis.	Crumpsall Workhouse.
" -	M. J. D.	F.	40 "	Wife of tailor -	Inquest	She died from arsenical poisoning.	Crumpsall Workhouse.
1901. Jan. -	M. A. T.	F.	61 "	Wife of wood case maker.	Certified	Peripheral neuritis, cardiac failure.	—
" -	M. S. -	F.	54 "	Widow of iron turner -	Certified	Alcoholic paralysis -	—
5 Feb. -	W. D. -	M.	53 "	Bill distributor -	Inquest	He died from cardiac failure, hastened by arsenical poisoning and tuberculosis.	Royal Infirmary.
3 " -	M. S. -	F.	54 "	Wife of plumber -	Certified	Phthisis, alcoholic peripheral neuritis	—
6 " -	A. R. -	F.	53 "	Wife of stationary fireman.	Certified	Alcoholic peripheral neuritis.	—
7 " -	J. T. -	M.	42 "	Bolt-maker -	Inquest	He died from uræmia, following peripheral neuritis from arsenical and alcoholic poisoning.	—
1 " -	A. M. -	F.	30 "	Charwoman -	Inquest	She died from cardiac failure, resulting from arsenical neuritis.	Crumpsall Workhouse.
10 " -	E. O. -	F.	43 "	Wife of plumber -	Inquest	She died from chronic arsenical poisoning taken in beer.	Royal Infirmary.
11 " -	B. E. -	M.	47 "	Joiner -	Inquest	He died from phthisis, accelerated by arsenical poisoning.	—
12 " -	C. M. -	F.	42 "	Wife of tailor -	Inquest	She died from tubercular disease, aggravated by arsenical poisoning.	Crumpsall Workhouse.
13 " -	A. S. -	F.	47 "	Wife of maker-up -	Inquest	She died from arsenical poisoning.	Crumpsall Workhouse.
13 " -	P. L. -	M.	37 "	Warehouse porter -	—	Peripheral neuritis, phthisis.	—
19 " -	B. F. -	F.	60 "	Wife of street sweeper	Inquest	She died from bronchitis and heart disease, aggravated by arsenical poisoning.	—

APPENDIX No. 5.

PAPERS handed in by MR. GORDON SALAMON.

Appendix
No. 5.FIRST AND SECOND REPORTS OF THE EXPERT COMMITTEE APPOINTED BY THE
MANCHESTER BREWERS' CENTRAL ASSOCIATION.

First Report, December 1st, 1900

Gentlemen,—Our investigations and inquiries so far as they have gone point to the conclusion that the materials in current use in brewing in Manchester are free from arsenic, with the exception of certain sugars supplied by Messrs. Bostock and Company, Limited, of Liverpool. In appearance and price these sugars are indistinguishable from perfectly pure sugars.

We therefore recommend to the Association the immediate adoption for the present of the following provisional precautions:—

1. That all beer in the brewing of which any sugar bought from Messrs. Bostock and Company, Limited, has been used should be at once recalled, and if found to be contaminated should be destroyed.
2. That no beer should be sent out until it has been tested and shown to be free from arsenic.
3. That a certificate of freedom from arsenic should be given in respect of beer so tested, and that only such beer should be sold.

In view of the importance of the subject we should recommend that the Association should take the management of the testing by its officials, and that the certificates should be issued in the name of the Association.

If these precautions be adopted we are of opinion that they will be effectual in preventing further mischief.

We desire to gratefully recognise the cordial co-operation and assistance of the Medical Officers of Health for Manchester and Salford, which have greatly lightened our labours.

We are, Gentlemen,
Yours faithfully,

(Signed) *Lauder Brunton,*
J. Fletcher Moulton,
Thos. Stevenson,
Alfred Gordon Salamon,
Arthur P. Luff,
Samuel Buckley.

Second Report December 15th, 1900.

Gentlemen,—The Commission has now examined the sugars and all the other materials used in brewing in Manchester (with the exception of the malt), and they consider that it is clearly established that the arsenic found in deleterious quantities in the beer has been solely due to the contamination by arsenic of the sugars supplied by Messrs. Bostock and Company, Limited, of Liverpool. The arsenic in these sugars was undoubtedly derived from the impure sulphuric acid used in their manufacture.

The measures recommended by the Commission a few days ago have, they learnt, been effectively carried out. The whole of the beer in the manufacture of which any Bostock sugar was used has been destroyed, and there is no further danger from this source.

All the other brewing sugars on the English market have been analysed, and have been found to be quite free from arsenic.

In view of the importance of the matter, the Commission have instituted inquiries as to the manufacture of brewing sugars in the United Kingdom, and in this they have been assisted by the whole of the manufacturers of such sugars—in a body—voluntarily offering them the opportunity of examining into the mode in which they conduct the manufacture. These manufacturers have stated collectively that it is, and always has been, their custom to use only acid free from arsenic, and they have requested the Commission to examine their invoices, works, etc., in order to verify these statements. Lack of time has prevented this being done by personal examination up to the present, but the fact that all the specimens of brewing sugars as well as of glucose used for other purposes on the market have been found to be free from arsenic, and the absence of any previous cases in which arsenic has been in such products, leave in the mind of the Commission no doubt that this statement, when examined into, will be found to be correct.

The Commission is quite unable to explain how Messrs. Bostock and Company, Limited, came to employ an acid

of the character actually used by them. The absolute necessity of using an acid free from arsenic in the manufacture of an article for human consumption must have been evident to everybody technically connected with the manufacture, and such acid is a common article of commerce. The price of the sugars in question was as high as any in the market, and, apart from this, the quantity of acid used in the manufacture of the sugars is so small that the difference in cost of the best and the worst would only make a difference of a fraction of a penny per hundredweight of sugar. So that it is not a case of an attempt to cheapen production by the use of lower priced materials. The Commission believe that it is this inexplicability which has rendered the matter so serious, and that the extent to which the mischief spread before it was detected was mainly due to the fact that the use of an acid containing arsenic in the manufacture of sugars was a contingency so improbable that it never occurred to those purchasing the sugars that it was possible that any danger could arise from that quarter.

The Commission has been unable to detect the presence of arsenic in brewing materials other than sugar supplied by Messrs. Bostock and Company, Limited, but they are aware that it has been asserted that traces of arsenic have been found in various samples of malt and hops. If such traces exist, they have probably been introduced in the operation of kilning, and the Commission propose to examine more fully into the matter. None of the specimens of hops have as yet yielded any traces. In any case, the amount so introduced would appear to be exceedingly minute, and not sufficient to have any deleterious effect.

The most important matter for the moment is to secure the adequate testing of beer in order that the public may be protected from all further mischief. Arsenic is a substance which can be detected in the most infinitesimal quantities by those who are practised in the tests, but these tests are so delicate that they are apt to mislead those who have not had experience in their application, and this is more particularly the case when the test is to be applied to a complex substance such as beer. Accordingly the Commission have thought it necessary to investigate and determine what is the most suitable method of testing beers for arsenic.

Test.—The Commission recommend that the Reinsch test should be used in preference to all others at present known, because their investigations have satisfied them that it is the best and most reliable test for arsenic in beer. The mode of performing it is as follows:—

Take 200 cc. of the beer in a porcelain evaporating dish. Raise the liquid to the boiling point, and then add 30 cc. of pure concentrated hydrochloric acid. Insert a piece of pure bright copper foil, about a quarter of an inch by half an inch in size, and keep the solution gently boiling for 45 minutes. If at the end of that time the copper remains bright and red, the beer is free from arsenic.

If a deposit is obtained on the copper the foil is to be washed successively with water, alcohol, and ether (care being taken that these are pure), dried at a temperature not exceeding 100° C., and subjected to slow sublimation in a thin reduction tube of small section, and not less than 2 inches long, the upper portion of which should be warmed before the sublimation begins. For the purpose of the sublimation a small spirit lamp flame should be used. If any sublimate is obtained, it must be examined under a magnifying power of about 200 diameters. Any sublimate which does not show well-defined octahedral or tetrahedral crystals is not to be considered arsenical.

N.B.—It must be borne in mind that the blackening of the copper or a deposit thereon from the preliminary operation does not demonstrate the presence of arsenic in beer. Abundant blackening and deposit may be obtained from the purest beer.

Lauder Brunton.
Thos. Stevenson.
Alfred Gordon Salamon.
Arthur P. Luff.
Samuel Buckley.
J. Fletcher Moulton.

PAPER HANDED IN BY MR. E. W. T. JONES.

Reprint of article in "Chemical News," Jan. 18, 1901.

ARSENIC IN BEER.

By MR. E. W. T. JONES.

I beg to lay before the readers of the "Chemical News" the method I have been using for the detection of arsenic in beer since the beginning of December last, when the scare inundated most public analysts like myself with beer samples. I do so, notwithstanding the report of the method published by the Commission of the Manchester Brewers' Association, because although in the main their method differs but little from mine, I personally prefer my procedure because it secures immediately on the addition of the acid the requisite conditions of Reinsch's test for the deposition of the arsenic on the copper. Before the addition of the hydrochloric acid there is no fear of arsenic being lost by the evaporation.

I also append the method I have employed with success for the estimation of the arsenic on the lines of Dr. Clark ("Journ. Chem. Soc.," 1893).

Qualitative Test.

250 c.c. of the beer are evaporated in a porcelain dish over a low Fletcher burner to about 100 c.c., then 25 c.c. of pure strong hydrochloric acid are added, and into the still boiling liquid is put a piece of fine copper gauze (I prefer this to foil), about 1 inch by $\frac{1}{2}$ inch, and the boiling continued for a quarter of an hour; if no darkening occurs by this time certainly less than 1-40th grain per gallon of arsenic is present. If the gauze is suspiciously darkened, wash with hot distilled water, then with alcohol, and dry. Roll up into a small size, and introduce into a small glass tube about 5 inches long, and heat the gauze with a very small flame whilst holding the tube in a horizontal position; examine any sublimate under the microscope, using a 1-5th objective. The tubing I have found very convenient is of elliptical section (I had it made originally for absorption spectroscopical work); it lies conveniently on the stage of the microscope, held on to the usual glass slips by two thin india-rubber bands, and I prepare such pieces of tube by drawing out to furnish a shoulder for the piece of gauze, and also that I may concentrate the sublimate in the narrower part.

Unmistakable octahedral or tetrahedral crystals of arsenious oxide are obtained without the least difficulty by the above procedure when 1-20th grain per gallon is present.

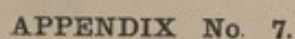
For glucose, syrups, jams, etc., I use 50 grms., and make to 100 c.c. at once with hot distilled water, and proceed in the same way.

To prepare the copper gauze - heat a strip about an inch wide to redness in a Bunsen burner, and then remove the black oxide with nitric acid, well wash, and dry; from these beautifully bright strips I cut pieces off about $\frac{1}{2}$ inch wide for the qualitative test, and about $3\frac{1}{2}$ inches long for the rolls I use for the quantitative tests.

Quantitative Test.

250 c.c. (or more) of the beer are evaporated as above in a porcelain dish to about 100 c.c., and 25 c.c. of pure strong hydrochloric acid added, then a piece of the pure bright copper gauze 1 inch \times $3\frac{1}{2}$ inches, in the shape of a loose roll, is put in, and the liquid is kept just on the boil with occasional stirring for, say, an hour, addition of hot distilled water being made from time to time to prevent the bulk by evaporation getting too small; considerable concentration is advantageous before the bulk is brought back with distilled water. The roll of gauze is now removed and washed with hot distilled water, the first washings being returned to the dish, and then another roll is put in, and the boiling continued.

The blackened and thoroughly washed roll is now put into a small beaker, $\frac{3}{4}$ inch diameter and $1\frac{1}{2}$ inch high, containing 5 c.c. N. sodic hydrate diluted to just cover the roll, and then three or four drops of a 10 vol. solution of peroxide of hydrogen solution added; by moving the coil up and down this solution is mixed, and on standing in the cold the gauze is gradually denuded of its black coating, and on acquiring its original colour is removed and washed into another larger beaker, these washings being reserved.



"SPOT MAP" OF THE COUNTY OF STAFFORDSHIRE, shewing Distribution of Cases of Poisoning by Arsenic in Beer.

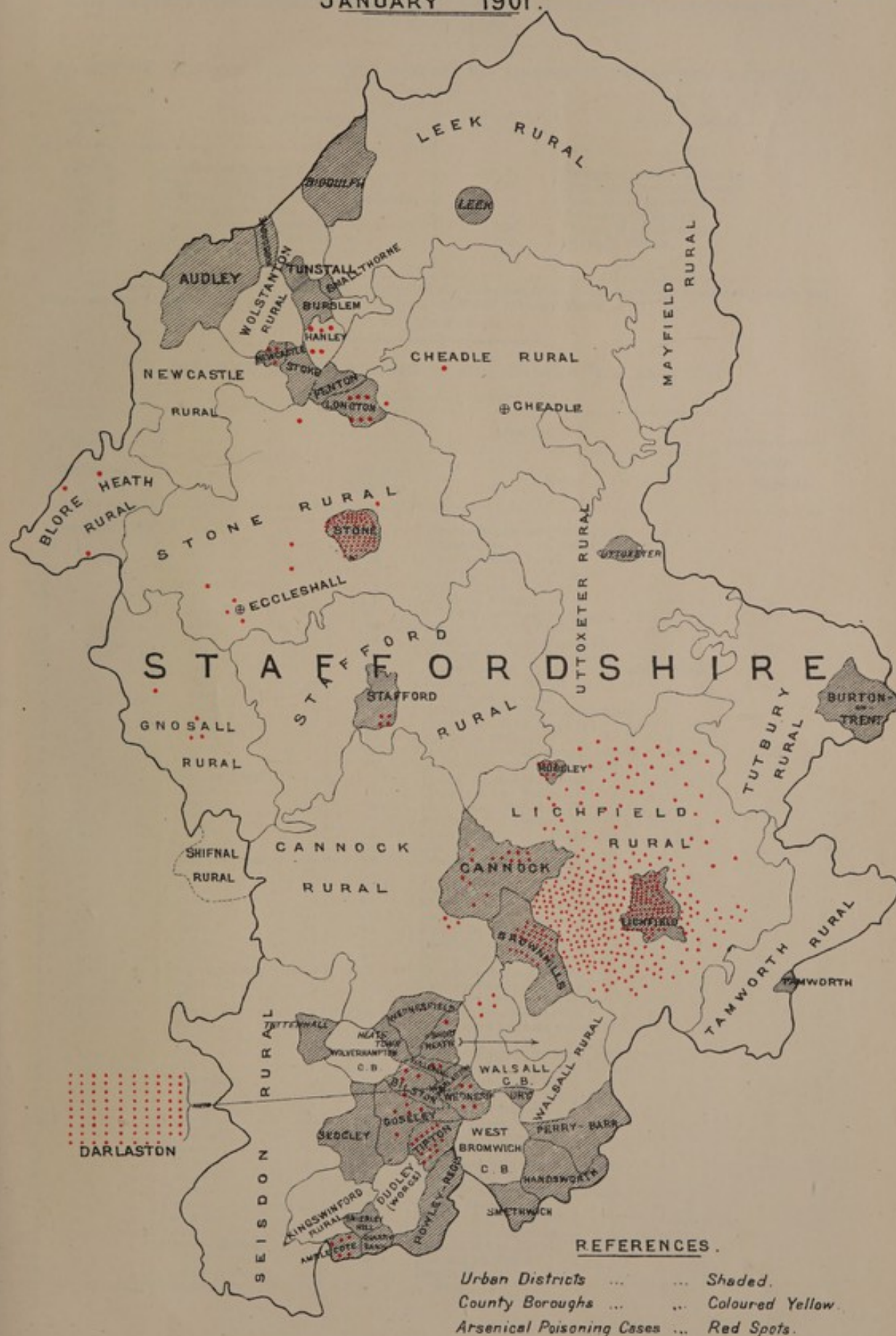
APPENDIX No. 7

STAFFORDSHIRE COUNTY COUNCIL.

APPROXIMATE NUMBER OF CASES OF POISONING BY ARSENIC IN BEER 667.

SPOT MAP HANDED IN BY D^R REID SHOWING DISTRIBUTION OF CASES.

JANUARY 1901.



STAFFORDSHIRE COUNTY COUNCIL
A statement of the accounts for the year ending 31st March 1901
and the balance sheet at that date
as audited by the auditors

STAFFORDSHIRE COUNTY COUNCIL
The accounts for the year ending 31st March 1901
show a balance of £1,000 0s 0d
in favour of the Council
and a balance of £1,000 0s 0d
in favour of the Council
at the end of the year

STAFFORDSHIRE COUNTY COUNCIL
The accounts for the year ending 31st March 1901
show a balance of £1,000 0s 0d
in favour of the Council
and a balance of £1,000 0s 0d
in favour of the Council
at the end of the year

APPENDIX No. 8.

INFORMATION FURNISHED BY DR. G. REID, SUPPLEMENTARY TO HIS EVIDENCE OF
13TH MARCH, 1901.

I.—LIST OF BREWERS WHOSE BEER WAS FOUND ARSENICAL IN COUNTY STAFFORD.

Distinctive Number.	Name of Brewery.	Distinctive Number.	Name of Brewery.
No. 1	Manchester Brewery Company.	No. 35	Newport Brewery Company.
" 3	Joule & Son, Stone.	" 47	Lichfield Brewery Company.
" 4	Ridgway & Co., Newcastle-under-Lyme.	" 54	Price, West Bromwich.
" 6	Farquhar's, Burslem.	" 56	Pritchard, Darlaston.
" 26	Market Drayton Brewery Company.	" 78	*Bates, West Bromwich.
" 27	Pearce & Co., Market Drayton.	" 88	Harper's, Bilston.
" 28	Wright & Co., Market Drayton.		

NOTE.—Brewery 5, to which Dr. Reid refers (Question 2000), as having come under suspicion on medical grounds but whose beer was not found arsenical by the County Analyst, was Bents' Brewery, Stone.

* Very minute trace.

II.—DETAILED LIST OF BREWERIES WHOSE BEER WAS ANALYSED

First Inquiry, 3 to 21 December 1901.

Date of Collection.	Sanitary District.	BREWERY.		Arsenic Present, Positive or Negative.
		Distinctive Number.	Name.	
3 December 1900	Longton	1	Manchester Brewery Company	+
3 "	"	2	Worthington & Co., Burton	—
3 "	"	3	Joule and Son, Stone	+
3 "	"	4	Ridgway & Co., Newcastle	+
3 "	Stoke-on-Trent	5	Bent's, Stone	—
3 "	"	6	Parker's, Burslem	+
3 "	Brownhills	47	Lichfield Brewery Company	+
3 "	"	89	Blencowe & Co., Cannock	—
3 "	"	90	Boulter and Sons, Brownhills	—
3 "	"	47	Lichfield Brewery Company	—
3 "	"	91	Home Brewed, "Hawthorn," Walsall Wood	—
3 "	"	22	Bindley & Co., Burton	—
3 "	"	70	Roberts', Brownhills	—
3 "	"	71	Lichfield City Brewery Company	—
3 "	"	85	Flower and Sons, Stratford	—
4 "	"	19	Showell's, Oldbury	—
4 "	"	87	South Stafford Brewery Company	—
4 "	"	50	Butler & Co., Wolverhampton	—
4 "	Stoke-on-Trent	7	Pim & Co., Stoke-on-Trent	—
4 "	"	8	Walker & Co., Burton	—
4 "	"	9	Bass & Co., Burton	—
4 "	"	10	Allsop & Co., Burton	—
4 "	"	11	Charrington & Co., Burton	—
4 "	"	12	Robinson & Co., Burton	—
4 "	Stoke-on-Trent	13	Bunting & Co., Uttoxeter	—
4 "	Burslem	14	Alton Brewery Company	—
4 "	"	15	Ind Coope & Co., Burton	—
4 "	"	16	Eley's Stafford Brewery	—
4 "	"	17	Malam,	—
4 "	"	18	Salt & Co., Burton	—
5 "	"	19	Showell's, Stoke-on-Trent	—
5 "	"	20	Burton Brewery Company	—
5 "	Stoke-on-Trent	19	Showell's, Stoke-on-Trent	—
5 "	Fenton	21	Stretton Brewery Company	—
5 "	"	14	Alton Brewery Company	—
5 "	Bilston	51	Woodall, West Bromwich	—
5 "	"	1	Manchester Brewery Company	—
5 "	"	19	Showell's, Oldbury	—
5 "	"	52	Wolverhampton and Dudley Company	—
5 "	"	53	Home Brewed, "Oak and Ivy Inn"	—
5 "	Wednesbury	54	Price, West Bromwich	+
5 "	"	55	Cheshire's Brewery Company	—
5 "	"	56	Pritchard, Darlaston	+
5 "	"	57	Home Brewed, "Noah's Ark"	—
5 "	"	47	Lichfield Brewery Company	+
6 "	Tipton	58	Jordan, Oldbury	—
6 "	"	59	Moore and Simpson, Perry Barr	—
6 "	"	60	Birmingham Brewery Company	—
6 "	Tipton	61	North Worcestershire Company	—
7 "	Fenton	5	Bent's, Stone	—
7 "	Longton	22	Bindley & Co., Burton	—
7 "	"	8	Walker & Co., Burton	—
7 "	Cheadle (Rural)	23	Truman & Co., Burton	—
7 "	"	24	Bell & Co., Burton	—
7 "	"	5	Bent's, Stone	—
7 "	Longton	5	" ditto	—

Appendix
No. 8.

II.—DETAILED LIST OF BREWERIES WHOSE BEER WAS ANALYSED—continued.

Date of Collection.	Sanitary District.	BREWERY.		Arsenic Present, Positive or Negative.
		Distinctive Number.	Name.	
7 December 1900	Longton	5	Bent's, Stone	—
7 "	- ditto	1	Manchester Brewery Company	—
7 "	Stone (Rural)	25	Home Brewed, "Bird-in-Hand," Hilderstone	—
7 "	Stone	5	Bent's, Stone	—
7 "	- ditto	5	- ditto.	—
7 "	- ditto	3	Joule & Son, Stone	+
7 "	Kingwinford (Rural)	62	Ellwell & Co., Brierly Hill	—
7 "	- ditto	63	Wordsley Brewery Company	—
7 "	- ditto	64	Worcestershire Company	—
7 "	- ditto	65	Home-Brewed, "Bird-in-Hand," Wordsley	—
7 "	- ditto	66	Home-Brewed, "George and Dragon," Wordsley.	—
7 "	- ditto	19	Showell's, Oldbury	—
8 "	Newcastle (Rural)	10	Allsop's, Burton	—
8 "	- ditto	26	Market Drayton Brewery Company	+
8 "	Blore Heath (Rural)	9	Bass & Co., Burton	—
8 "	- ditto	27	Pearce & Co., Market Drayton	+
8 "	- ditto	28	Wright & Co., Market Drayton	+
8 "	Stone (Rural)	16	Eley's Stafford Brewery	—
8 "	Bilston	5	Bent's, Stone	—
8 "	- ditto	56	Pritchard, Darlaston	—
8 "	Darlaston	54	Price, West Bromwich	—
8 "	- ditto	54	- ditto. ditto.	+
8 "	- ditto	47	Lichfield Brewery Company	—
8 "	- ditto	56	Pritchard, Darlaston	—
8 "	Willenhall	1	Manchester Brewery Company	—
8 "	- ditto	67	Home Brewed, "Old Oak," Willenhall	—
8 "	- ditto	68	Hamilton, Day & Co. (?)	—
9 "	Stone (Rural)	29	Home Brewed, "Wharf Inn," Shebdon	—
9 "	Gnosall (Rural)	30	Potts & Co. (?)	—
9 "	- ditto	31	Home-Brewed, "Junction Inn," Norbury	—
9 "	- ditto	32	Home-Brewed, "Cock Inn," Woodseaves	—
10 "	Stone (Rural)	33	Dix & Co., Hanley	—
10 "	- ditto	16	Eley's Stafford Brewery	—
10 "	Gnosall (Rural)	34	Home-Brewed, Whitehouse, Innkeeper	—
10 "	- ditto	35	Newport Brewery Company	+
10 "	- ditto	36	Wrekin Brewery Company	—
10 "	- ditto	37	Parton, Great Chatwell, H.B.	—
10 "	- ditto	38	Baker, Great Chatwell, H.B.	—
10 "	- ditto	39	Shifnal Brewery Company	—
10 "	Wednesfield	1	Manchester Brewery Company	—
10 "	- ditto	19	Showell's, Oldbury	—
10 "	Cannock (Rural)	69	Bloxwich Brewery Company	—
10 "	Walsall (Rural)	47	Lichfield Brewery Company	+
10 "	- ditto	3	Joule & Son, Stone	+
10 "	- ditto	70	Roberts', Brownhills	—
10 "	Tamworth	71	Lichfield City Brewery Company	—
10 "	- ditto	72	Smith, Aston	—
10 "	Tamworth (Rural)	73	Eadie & Co., Burton	—
10 "	Cannock (Rural)	87	South Stafford Brewery Company	—
11 "	Wednesbury	74	Home Brewed, "Royal Exchange"	—
11 "	- ditto	75	- ditto - "Robin Hood"	—
11 "	- ditto	76	Well Head Brewery Company, Perry Barr	—
11 "	- ditto	54	Price, West Bromwich	—
11 "	- ditto	77	Home Brewed, "Park Inn"	—
11 "	- ditto	8	P. Walker, Burton	—
11 "	- ditto	78	Bates, West Bromwich	+
11 "	- ditto	79	Homed Brewed, "Rising Sun"	—
12 "	Lichfield (Rural)	80	Cooper & Co., Burton	—
12 "	Wolstanton (Rural)	40	Hedge & Co., Stoke	—
13 "	Longton	41	Steele, Market Drayton	—
13 "	Stafford	42	Home Brewed, "Angel Inn"	—
13 "	- ditto	43	- ditto - "Waggon and Horses"	—
13 "	- ditto	44	- ditto - "Prince Albert"	—
13 "	- ditto	45	- ditto - "Princess Royal"	—
13 "	- ditto	46	- ditto - "Maltster's Arms"	—
13 "	- ditto	47	Lichfield Brewery Company	+
13 "	- ditto	48	Home Brewed, "Star and Garter"	—
14 "	- ditto	49	- ditto - "Castle Inn"	—
14 "	- ditto	50	Butler & Co., Wolverhampton	—
14 "	Wolstanton (Rural)	6	Parker's, Burslem	+
14 "	- ditto	6	Parker's, Burslem	+
14 "	Stoke-on-Trent	3	Joule and Son, Stone	+
15 "	Wednesbury	56	Pritchard, Darlaston	—
15 "	- ditto	81	Yardley & Co., Wolverhampton	—
15 "	- ditto	54	Price, West Bromwich	—
17 "	Seisdon (Rural)	82	Rollaston, Niterton	—
17 "	- ditto	61	North Worcestershire Company	—
17 "	- ditto	83	Hanson, Dudley	—
17 "	- ditto	84	Home Brewed, "Elm Tree Inn," Kinver	—
17 "	- ditto	85	Flower and Sons, Stratford	—
17 "	- ditto	20	Burton Brewery Company	—
20 "	Newcastle (Rural)	19	Showell's, Stoke	—
21 "	Stone (Rural)	5	Bent's, Stone	—
21 "	Willenhall	86	Home Brewed, "Tumbledown Bridge," Willenhall.	—

* Very minute trace.

II.—DETAILED LIST OF BREWERIES WHOSE BEER WAS ANALYSED—*continued.*Appendix
No. 8.*Second Inquiry.*—January and February 1901.

Date of Collection.	Sanitary District.	BREWERY.		Arsenic Present, Positive or Negative.
		Distinctive Number.	Name.	
17 January 1901	Quarry Bank	—	Home Brewed, "New Inn"	—
17 " "	- ditto	—	- ditto - "White Horse"	—
17 " "	- ditto	—	Nock, Quarry Bank	—
7 February " "	Wolstanton (Rural)	6	Parker's, Burslem	—
7 " "	- ditto	6	- ditto	—
7 " "	Longton	1	Manchester Brewery Company	—
7 " "	- ditto	3	Joule and Son, Stone	—
7 " "	Fenton	4	Ridgway & Co., Newcastle	—
7 " "	Stoke-on-Trent	3	Joule and Son, Stone	—
7 " "	- ditto	6	Parker's, Burslem	—
7 " "	Stone	3	Joule and Son, Stone	—
8 " "	Gnosall (Rural)	35	Newport Brewery Company	—
8 " "	Stafford	?	?	—
8 " "	Cheadle (Rural)	3	Joule and Son, Stone	—
8 " "	- ditto	24	Bell & Co., Burton	—
11 " "	Darlaston	47	Lichfield Brewery Company, Limited	—
11 " "	Wednesbury	54	A. J. Price, West Bromwich	—
11 " "	- ditto	56	Pritchard, Darlaston	—
11 " "	- ditto	78	Bates, Sponwell Brewery	—
11 " "	- ditto	47	Lichfield Brewery Company, Limited	—
13 " "	Blore Heath (Rural)	27	Pearce & Co., Market Drayton	—
13 " "	Gnosall (Rural)	28	Wright & Co., Market Drayton	—
14 " "	Blore Heath (Rural)	28	- ditto - ditto	—
14 " "	- ditto	27	Pearce & Co., Market Drayton	—
14 " "	- ditto	28	Wright & Co., Market Drayton	—
14 " "	Newcastle (Rural)	26	Market Drayton Brewery Company	—
14 " "	- ditto	3	Joule and Son, Stone	—
17 " "	Cheadle (Rural)	3	- ditto - ditto	—
18 " "	Stafford	47	Lichfield Brewery Company, Limited	—
18 " "	- ditto	47	- ditto - ditto	—
18 " "	Sedgley	—	Home Brewed, "Limerick," Gornall	—
18 " "	- ditto	52	Wolverhampton and Dudley Brewery Com- pany.	—
18 " "	- ditto	—	Atkinson, Aston Park Brewery	—
18 " "	Coseley	52	Wolverhampton and Dudley Brewery Com- pany.	—
18 " "	Bilston	83	Hanson and Sons, Dudley	—
19 " "	Wolstanton (Rural)	4	Ridgway & Co., Newcastle	—
19 " "	- ditto	4	- ditto - ditto	—
19 " "	Stoke-on-Trent	6	Parker's, Burslem	—
19 " "	- ditto	6	- ditto	—
19 " "	Longton	1	Manchester Brewery Company	—
19 " "	Fenton	1	- ditto - ditto	—
20 " "	Gnosall (Rural)	35	Newport Brewery Company	—
20 " "	- ditto	35	- ditto - ditto	—
23 " "	Cannock (Rural)	88	Harper, Bilston	—

An appreciable
though not
large amount.

III.—GLUCOSE SAMPLES ANALYSED.

Date of Collection.	Sanitary District.	Source from which obtained.		Arsenic Present, Positive or Negative.
		Distinctive Number.	Name.	
3 December 1900	Brownhills	92	Shire Oak Brewery	—
3 " "	- ditto	92	- ditto	—
3 " "	- ditto	92	- ditto	—
3 " "	- ditto	92	- ditto	—
3 " "	- ditto	93	Hawthorn Inn, Walsall Wood	—
7 " "	Lichfield	47	Lichfield Brewery Company	+
7 " "	- ditto	47	- ditto ditto	—
7 " "	- ditto	47	- ditto ditto	—
9 " "	Newcastle	94	Butterworth, Newcastle	—
10 " "	Bilston	88	Harper, Bilston	+
12 " "	Newcastle	95	Hickman, Newcastle	—

Appendix
No. 8.

IV.—SAMPLES OF CONFECTIONERY AND GOLDEN SYRUP ANALYSED.

Date of Collection.	District.	Nature of Sample.	From whom purchased.	Arsenic Present, Positive or Negative.
18 January 1901	Dracott-le-Moors	Confectionery	Henry Ridge	—
4 February	Whiston	ditto	Charles Pattison	—
4	Oakamoor	ditto	William Moseley	—
5	Cobridge	Golden Syrup	John Draycott	—
5	ditto	ditto	John Frearson	—
5	ditto	ditto	ditto	—
5	Barslem	ditto	Thomas William Berrisford	—
5	ditto	ditto	Frederick Clarke	—
5	ditto	Confectionery	Stephen Upton	—
5	ditto	ditto	ditto	—
5	ditto	ditto	Herbert Blaize	—
5	ditto	ditto	ditto	—
5	ditto	ditto	James Morton	—
5	ditto	ditto	Eliza Wood	—
26	Hixon	ditto	Catherine Murragh	—

APPENDIX No. 9.

Appendix
No. 9.TABLES handed in by Mr. *Estcourt*, showing results of EXAMINATION of certain SAMPLES submitted to him as Public Analyst.

I. SAMPLES other than Beer analysed for Arsenious Acid.

	Mineral Waters.	Golden Syrup.	Sweets.	Jam.	Honey.
Received from Corporation of—					
Manchester - - - - -	22	8	25	27	—
Oldham - - - - -	—	—	—	4	6
Ashton-under-Lyne - - - -	12	—	3	1	—
Macclesfield, Bacup, and Lancaster	—	—	—	—	—

No trace of Arsenious Acid was found in any of the above samples.

A.—MANCHESTER.

II. SAMPLES of Beer examined for Arsenious Acid.

Five breweries, beer from each examined several days in November and December, 1900. Results in grains As_2O_3 per gallon.

				November			December.										
				21	21	24	1	3	4	5	6	8	10	14	15	19	20
Brewery 1 - - - -				$\frac{1}{8}$	$\frac{1}{50}$	-	$\frac{1}{8}$	-	$\frac{1}{15}$	-	-	$\frac{1}{50}$	$\frac{1}{100}$ $\frac{1}{100}$ $\frac{1}{100}$	$\frac{1}{100}$	-	-	-
" 2 - - - -				$\frac{1}{8}$	$\frac{1}{8}$	-	-	$\frac{1}{8}$	-	-	$\frac{1}{8}$	-	-	-	-	$\frac{1}{50}$	-
" 3 - - - -				$\frac{1}{4}$	$\frac{1}{15}$	-	-	-	-	-	$\frac{1}{500}$	-	-	-	-	-	-
" 4 - - - -				$\frac{1}{8}$	$\frac{1}{50}$	-	$\frac{1}{8}$	$\frac{1}{15}$	-	-	$\frac{1}{8}$	$\frac{1}{50}$	-	$\frac{1}{100}$	-	-	-
" 5 - - - -				-	-	$\frac{1}{100}$	$\frac{1}{8}$	-	-	-	-	-	$\frac{1}{100}$ and $\frac{1}{50}$	-	-	-	-

Other 45 Breweries, Beer from each examined occasionally in November and December, 1900. Results in grains As_2O_3 per gallon.

Brewery Number.	Date of collection of Sample.	Grains Arsenic per gallon.	Brewery Number.	Date of collection of Sample.	Grains Arsenic per gallon.
6	Nov. 21	$\frac{1}{100}$	28	Jan. 16 or 18	0
6	" 24	$\frac{1}{100}$	29	" 16 or 18	0
7	" 21	$\frac{1}{50}$	30	" 16 or 18	0
7	" 24	0	31	" 16 or 18	0
8	" 21 & 24	0	32	" 16 or 18	0
9	" 21 & 24	0	33	" 18	0
10	" 21 & 24	0	34	" 18	0
11	" 21 & 24	0	35	" 18	$\frac{1}{100}$
12	" 21 & 24	0	36	" 18	0
13	" 21 & 24	0	37	" 18	0
14	" 21 & 24	0	38	" 22 or 24	0
15	Dec. 14	$\frac{1}{100}$	39	" 22 or 24	0
16	" 14	$\frac{1}{100}$	40	" 22 or 24	0
17	" 14	$\frac{1}{100}$	41	" 22 or 24	0
18	" 14	$\frac{1}{100}$	42	" 24	0
19	" 14	$\frac{1}{100}$	43	" 24	0
20	" 14	$\frac{1}{100}$	44	" 24	0
21	" 14	$\frac{1}{100}$	45	Feb. 1	$\frac{1}{100}$
22	" 14	$\frac{1}{100}$	46	" 1	$\frac{1}{100}$
23	" 14	$\frac{1}{100}$	47	" 6	0
24	Jan. 16 or 18	0	48	" 6	0
25	" 16 or 18	$\frac{1}{50}$	49	" 14	0
26	" 16 or 18	$\frac{1}{100}$	50	" 14	$\frac{1}{100}$
27	" 16 or 18	$\frac{1}{100}$			

Appendix
No. 9.

SUMMARY of Above :—Results of Analyses of 81 Samples of Beer brewed by 50 Brewers.

No. of Samples.	Amount of As_2O_3 per gallon.
1	$\frac{1}{2}$
10	$\frac{1}{4}$
1	$\frac{1}{8}$
1	$\frac{1}{16}$
2	$\frac{1}{32}$
1	$\frac{1}{64}$
2	$\frac{1}{128}$
8	$\frac{1}{256}$
22	$\frac{1}{512}$
5	$\frac{1}{1024}$
28	0

21 brewers of Arsenicated Beer : 19 less than $\frac{1}{20}$ grain, 5 not more than $\frac{1}{20}$.

B.—ASHTON UNDER LYNE CORPORATION.

SAMPLES analysed from 26th November to 4th February.

No. of Samples of Beer.	Amount of As_2O_3 per gallon.	No. of Samples of
1	$\frac{1}{2}$ grain	Mineral Waters 12 No. As_2O_3
2	$\frac{1}{4}$ "	Sweets 3 "
1	$\frac{1}{8}$ "	Jam 1 "
1	$\frac{1}{16}$ "	
6	$\frac{1}{32}$ "	
1	$\frac{1}{64}$ "	
2	$\frac{1}{128}$ "	
8	$\frac{1}{256}$ "	
1	$\frac{1}{512}$ "	
17	0	
Total 40		

C.—MACCLESFIELD CORPORATION.

SAMPLES of Beer analysed from 28th November to 21st December.

No. of Samples.	Amount of As_2O_3 per gallon.
1	$\frac{1}{2}$ grain
12	$\frac{1}{4}$ "
3	$\frac{1}{8}$ "
7	$\frac{1}{16}$ "
11	$\frac{1}{32}$ "
	0
Total 24	

D.—LANCASTER CORPORATION.

SAMPLES of Beer analysed from 6th December to 12th December.

No. of Samples.	Amount of As_2O_3 per gallon.
1	$\frac{1}{2}$ grain
1	$\frac{1}{4}$ "
2	$\frac{1}{8}$ "
12	$\frac{1}{16}$ "
8	$\frac{1}{32}$ "
8	0
Total 22	

Appendix
No. 10.

APPENDIX No. 10.

TABLES handed in by Mr. *Edward Sergeant*.

COUNTY PALATINE OF LANCASTER.

TABLE I.

LIST of SAMPLES of BEER (including Ales, Stouts, &c.) purchased for analysis between 27th November 1900, and 28th February 1901, by the County Police acting on the instructions of the County Medical Officer of Health. For Summary see Table II.

(Note.—Samples purchased prior to 4th December were "preliminary" samples, and not followed by legal proceedings).

Sample Number and Police Division.	Date of Purchase.	Sanitary District.	House "tied" or "free."	Price of beer per quart.	Brewery Distinctive Number.	Result of Analysis (See foot note.)	Remarks.
84 SD	1900 : 27 Nov.	Waterloo-with-Seaforth	Tied	d.			
85 "	"	"	"	5	27	c	
86 "	"	"	"	5	152	c	
87 "	"	"	"	5	28	a	
88 "	"	"	"	5	89	a	
89 "	"	Litherland	"	5	30	a	
90 "	"	"	"	5	153	c	
481 PD	"	"	"	5	84	c	
482 "	"	Huyton-with-Roby	"	5	32	a	
483 "	"	Prescot	"	5	71	a	
484 "	"	"	"	5	162	a	
485 "	"	"	"	5	27	a	
486 "	"	"	"	5	72	a	
487 "	"	"	"	5	92	a	
280 Ws D	"	Whiston (Rural)	"	6	71	a	
281 "	"	"	"	6	45	a	
282 "	"	"	"	6	46	a	
283 "	"	Widnes (Borough)	"	6	72	a	
284 "	"	"	"	6	168	a	
285 "	"	"	"	6	162	a	
286 "	"	"	"	6	33	b	
287 "	"	"	"	6	92	a	
183 WD	"	Leigh (Borough)	"	5	6	a	
184 "	"	"	"	5	33	a	
66 Wgn D	"	Ashton-in-Makerfield	"	5	4	c	
67 "	"	"	"	5	71	a	
68 "	"	"	"	5	63	a	
688 By D	28 Nov.	Ramsbottom	"	4	23	a	
689 "	"	"	"	6	43	a	
823 MD	"	Moss Side	"	4	105	a	
824 "	"	"	"	4	97	a	
825 "	"	"	"	4	86	a	
826 "	"	"	"	6	154	c	
827 "	"	"	"	4	87	a	
828 "	"	Stretford	"	4	162	a	
829 "	"	"	"	4	69	a	
830 "	"	Moss Side	"	4	163	a	
646 OD	"	Ormskirk	"	5	56	a	
647 "	"	"	"	7	56	a	
648 "	"	"	"	5	153	c	
649 "	"	"	"	7	153	a	
185 WD	"	Newton-in-Makerfield	"	5	169	a	
186 "	"	"	"	5	71	a	
187 "	"	"	"	5	36	a	
188 "	"	Warrington (Rural)	Free	5	63	b	
69 Wgn D	"	Hindley	Tied	4	156	a	
70 "	"	Ince-in-Makerfield	"	4	111	a	
71 "	"	"	"	4	118	c	
72 "	"	"	"	4	141	a	
60 HBD	29 Nov.	Nelson (Borough)	"	5	94	c	
61 "	"	"	"	4½	133	c	
62 "	"	"	"	5	3	a	
691 By D	"	Radcliffe	"	4	51	c	
694 "	"	Heywood (Borough)	"	4	121	a	
91 SD	"	Litherland	"	5	27	c	
92 "	"	Waterloo-with-Seaforth	"	5	152	b	
93 "	"	Litherland	"	5	153	c	
224 Km D	30 Nov	Kirkham	"	4	38	c	
1450 Rs D	"	Rawtenstall (Borough)	"	3	17	a	

(a) Genuine, or free from arsenic.

(b) Slightly arsenicated but passable.

(c) Containing quantity of arsenic injurious to health.

List of Samples of Beer (including Ales, Stouts, &c.)—continued.

Appendix
No. 10.

Sample Number and Police Division.	Date of Purchase.	Sanitary District.	House "tied" or "free."	Price of beer per quart.	Brewery Distinctive Number.	Result of Analysis. (See foot note.)	Remarks.
313 LD	1900 : 30 Nov.	Standish-with-Langtree	Tied	d	4	c	
94 SD	"	Litherland	"	5	84	a	
95 "	"	Waterloo-with-Seaforth	"	5	153	c	
190 WD	"	Leigh (Borough)	"	6	33	a	
73 Wga D	"	Hindley	"	5	156	a	
1340 RD	1 Dec.	Chadderton	"	5	102	a	
838 MD	"	Moss Side	"	6	154	a	
82 NLD	3 Dec.	Dalton-in-Furness	"	6	73	b	
83 "	"	"	"	6	73	b	
317 LD	"	Chorley (Borough)	"	—	78	a	
318 "	"	"	"	—	149	c	
839 MD	"	Eccles (Borough)	"	4	179	a	
840 "	"	"	"	4	88	a	
841 "	"	"	"	4	123	a	
488 PD	"	Prescot	"	5	46	a	
191 WD	"	Warrington (Rural)	"	5	63	c	
84 NLD	4 Dec.	Dalton-in-Furness	"	6	49	a	
85 "	"	"	"	5	37	c	Report received too late for prosecution.
86 "	"	"	"	6	73	b	
87 "	"	"	"	5	74	b	
89 "	"	Ulverston	Brewery	—	73	b	
63 HBD	"	Colne (Borough)	Tied	5	59	c	Prosecution. Fined 20s. and costs.
1451 Rs D	"	Rawtenstall (Borough)	"	3	98	a	
1452 "	"	"	"	3	147	a	
871 Bn D	"	Little Lever	"	4	82	c	Prosecution withdrawn after fine indicted sample No. 872.
872 "	"	"	"	6	82	c	Prosecution. Fined 5l and costs.
873 "	"	Kearsley	"	4	69	c	Prosecution. Fined 5l and costs.
874 "	"	"	"	6	69	b	
842 MD	"	Withington	"	4	109	a	
843 "	"	"	Free	4	69	a	
844 "	"	"	Tied	4	87	a	
650 OD	"	Ormskirk	"	7	153	a	
651 "	"	"	"	5	153	c	Prosecution. Fined 5l and costs.
652 "	"	"	"	7	31	a	
653 "	"	"	"	5	31	a	
654 "	"	"	"	7	31	a	
655 "	"	Lathom and Burscough	"	7	153	a	
656 "	"	"	"	5	153	c	Prosecution. Case adjourned pending decision of higher court.
657 "	"	Birkdale	"	7	138	a	
658 "	"	"	"	5	138	a	
659 "	"	"	"	7	158	a	
660 "	"	"	"	5	158	a	
700 By D	5 Dec.	Heywood (Borough)	"	4	102	a	
701 "	"	"	"	4	123	a	
702 "	"	"	"	4	121	b	
846 MD	"	Swinton and Pendlebury	"	4	171	c	No prosecution. Sample obtained from sealed barrel at request of Analyst.
847 "	"	"	"	4	123	a	
848 "	"	"	"	4	136	c	Prosecution. Dismissed on grounds that summons issued under wrong section. Appeal pending.
849 "	"	"	"	3	142	b	
1453 Rs D	6 Dec.	Haslingden (Borough)	"	3	148	a	
1454 "	"	"	"	3	113	a	
1455 "	"	"	"	3	67	b	
225 Km D	7 Dec.	Kirkham	"	4	14	a	
226 "	"	"	"	4	158	a	
227 "	"	"	"	4	161	c	Prosecution. Fined 5l and costs.
228 "	"	"	"	4	13	a	
876 Bn D	"	Westhoughton	"	4	83	a	
877 "	"	"	"	6	83	a	
879 "	"	Aspull	Free	6	91	a	
880 "	"	"	"	6	91	a	

(a)—Genuine, or free from arsenic.

(b)—Slightly arsenicated but passable.

(c)—Containing quantity of arsenic injurious to health.

List of Samples of Beer (including Ales, Stouts, &c.)—*continued.*Appendix
No. 10.

Sample Number and Police Division.	Date of Purchase.	Sanitary District.	House "tied" or "free."	Price of beer per quart.	Brewery Distinctive Number.	Result of Analysis. (See foot note.)	Remarks.
1553 RD	1900 : 7 Dec.	Middleton (Borough)	Tied	d 4	55	c ½th grain per gal.	Prosecution. Adjourned pending decision of higher court.
297 SLD	8 Dec.	Morecambe	"	5	174	a	
298 "	"	"	"	5	175	a	
299 "	"	"	"	5	106	a	
850 MD	"	Reddish	"	4	145	a	
851 "	"	Eccles (Borough)	"	4	10	a	
852 "	"	Reddish	"	4	35	a	
853 "	"	"	"	4	97	a	
64 HBD	10 Dec.	Padiham	"	5	41	b	
65 "	"	"	"	5	148	a	
854 MD	"	Eccles (Borough)	"	4	14	a	
855 "	"	"	"	4	163	c ½th grain per gal.	Prosecution. and costs. Fined £5 Appeal pending.
856 "	"	"	"	4	86	a	
857 "	"	"	"	4	172	a	
858 "	"	"	"	4	145	b	
859 "	"	"	Free	4	115	a	
860 "	"	"	"	4	44	a	
861 "	"	"	Tied	4	100	a	
862 "	"	"	"	4	69	b	
66 HBD	11 Dec.	Nelson (Borough)	"	5	80	a	
67 "	"	"	"	5	3	a	
68 "	"	"	"	4½	133	c ½th grain per gal.	Prosecution. and costs. Fined £3
69 "	"	"	"	5	94	a	
70 "	"	"	"	5	68	b	
914 Ac D	"	Clitheroe (Borough)	"	2½	81	a	
915 "	"	"	"	3½	81	a	
1456 Rs D	"	Rawtenstall (Borough)	"	3	3	a	
1457 "	"	"	"	3	95	a	
1458 "	"	"	"	3	107	b	
1459 "	"	"	"	3	18	b	
84 Wgn D	12 Dec.	Upholland	"	5	65	a	
85 "	"	"	"	5	69	a	
86 "	"	"	"	5	64	a	
87 "	"	Orrell	"	5	2	a	
88 "	"	"	"	5	7	a	
89 "	"	Pemberton	"	4	8	a	
703 Ry D	13 Dec.	Ramsbottom	Free	4	60	a	
704 "	"	"	Tied	4	67	c ½th grain per gal.	Prosecution dismissed on the ground that analyst's certificate was insufficient. Appeal pending.
705 "	"	Radcliffe	Free	6	163	a	
706 "	"	"	Tied	4	42	c ½th grain per gal.	Prosecution. Fined 20s. and costs.
850 GD	14 Dec.	Garstang (Rural)	"	5	174	b	
851 "	"	"	"	5	160	c ¾th grain per gal.	Prosecution. and costs. Fined 20s.
863 MD	"	Gorton	"	6	173	a	
864 "	"	"	"	4	155	a	
865 "	"	"	"	4	143	b	
866 "	"	"	"	4	14	a	
867 "	"	Levenshulme	"	5	144	b	
868 "	"	"	"	4	47	a	
869 "	"	"	"	4	163	a	
870 "	"	"	"	4	44	a	
871 "	15 Dec.	Eccles (Borough)	"	4	162	a	
872 "	"	"	"	4	142	b	
873 "	"	"	"	4	97	a	
874 "	"	"	Free	4	66	b	
875 "	"	"	Tied	4	117	a	
876 "	"	"	Free	6	48	a	
707 Ry D	17 Dec.	Heywood (Borough)	Tied	7	121	a	
708 "	"	"	"	7	121	a	
709 "	"	"	"	7	121	a	
852 GD	18 Dec.	Garstang (Rural)	Free	5	106	a	
853 "	"	"	"	5	161	c ½ grain per gal.	Prosecution. and costs. Fined 20s.
854 "	"	"	Tied	5	159	a	
855 "	"	"	Free	5	175	a	
192 WD	"	Leigh (Borough)	Tied	5	44	b	
193 "	"	"	"	5	42	a	

(a)—Genuine, or free from arsenic.

(b)—Slightly arsenicated, but passable.

(c)—Containing quantity of arsenic injurious to health.

List of Samples of Beer (including Ales, Stouts, &c.)—continued.

Appendix
No. 10.

Sample Number and Police Division.	Date of Purchase.	Sanitary District.	House "tied" or "free."	Price of beer per quart.	Brewery Distinctive Number.	Result of Analysis. (See foot note.)	Remarks.
1354 RD	1900 : 20 Dec.	Littleborough	Tied	d. 4	26	c 1/4th grain per gal.	Prosecution. Sample sent to Somerset House. Case dismissed on technical point.
1355 "	"	"	"	4	44	a	
1356 "	"	"	"	4	117	a	
1357 "	"	Whitworth	"	4	23	a	
1358 "	"	"	"	4	121	a	
1359 "	"	"	Free	4	98	a	
71 HBD	22 Dec.	Nelson (Borough)	Tied	3	133	c 1/2 grain per gal.	Prosecution. Fined 3s. and costs.
856 GD	1901 : 1 Jan.	Garstang (Rural)	"	5	160	c 1/4th grain per gal.	No prosecution. Sample taken from a sealed barrel.
857 "	2 Jan.	Fulwood	"	4	13	a	
858 "	"	"	"	4	14	c 1/4th grain per gal.	Prosecution pending.
859 "	"	"	"	4	13	a	
877 MD	"	Urmston	"	4	69	b	
878 "	"	"	"	6	2	b	
879 "	"	"	"	4	145	b	
880 "	"	"	"	4	154	b	
96 SD	3 Jan.	Waterloo-with-Seaforth	Free	5	53	a	
97 "	"	Crosby	Tied	5	45	a	
98 "	"	Waterloo-with-Seaforth	"	5	30	a	
99 "	"	"	"	5	159	a	
229 Km D	4 Jan.	Fleetwood	"	5	39	a	
230 "	"	"	"	5	162	a	
231 "	"	"	"	5	145	a	
232 "	"	"	Free	6	50	a	
300 SLD	7 Jan.	Lancaster (Rural)	Tied	5	14	b	
301 "	"	"	Free	6	93	b	
302 "	"	Morecambe	Tied	5	150	b	
303 "	"	"	"	5	14	b	
233 Km D	"	Preston (Rural)	Free	5	160	c 1/4th grain per gal.	Prosecution. Fined 40s. costs.
234 "	"	Kirkham	"	4	161	b	
320 LD	"	Preston (Rural)	"	4	79	b	
860 GD	8 Jan.	Garstang (Rural)	Tied	5	160	c 1/4th grain per gal.	Prosecution. Fined 20s. and and costs. 1
861 "	"	Preston (Rural)	Free	4	113	c 1/4th grain per gal.	Prosecution. Fined 40s. and costs.
321 LD	"	Chorley (Borough)	Tied	4	160	b	
882 Bn D	"	Turton	"	4	82	a	
883 "	"	"	"	6	82	a	
884 "	"	"	"	4	135	a	
885 "	"	"	"	6	135	a	
661 OD	9 Jan.	Ormskirk	"	5	56	a	
662 "	"	"	"	7	56	a	
663 "	"	"	"	5	153	a	
664 "	"	"	"	7	153	a	
665 "	"	West Lancashire (Rural)	"	5	70	a	
666 "	"	"	"	7	70	a	
90 NLD	10 Jan.	Ulverston (Rural)	Free	5	93	a	
91 "	"	"	"	5	101	a	
92 "	"	"	"	5	57	a	
93 "	"	"	"	5	125	a	
94 "	"	"	Tied	5	1	a	
95 "	"	"	Free	5	73	a	
96 "	"	"	Tied	6	11	a	
97 "	"	Grange	Free	6	157	a	
98 "	"	"	Tied	5	126	a	
304 SLD	"	Morecambe	"	5	113	a	
305 "	"	"	Free	5	151	a	
306 "	"	"	Tied	5	148	a	
802 GD	"	Garstang (Rural)	"	5	174	a	
803 "	"	"	Free	5	175	a	
881 MD	"	Swinton and Pendlebury	"	4	171	c 1/4th grain per gal.	Prosecution. Adjourned pending decision of higher Court.
882 "	"	"	Tied	4	88	b	
883 "	"	"	"	4	69	b	
884 "	"	"	"	3	142	c 1/4th grain per gal.	Prosecution. Adjourned pending decision of higher Court.
710 By D	14 Jan.	Heywood (Borough)	"	6	24	a	

(a)—Genuine, or free from arsenic.

(b)—Slightly arsenicated, but passable.

(c)—Containing quantity of arsenic injurious to health.

Appendix
No. 10.

List of Samples of Beer (including Ales, Stouts, &c.)—continued.

Sample Number and Police Division.	Date of Purchase.	Sanitary District.	House "tied" or "free."	Price of beer per quart.	Brewery Distinctive Number.	Result of Analysis. (See footnote.)	Remarks.
711 By D	1901 : 14 Jan.	Heywood (Borough)	Tied	d. 4	121	c ½th grain per gal.	Prosecution. Fined 40s. and costs.
712 "	"	Radcliffe	"	4	51	a	
713 "	"	"	"	4	52	a	
892 Bn D	16 Jan.	Horwich	"	6	145	a	
893 "	"	"	"	6	54	a	
100 SD	"	Litherland	"	5	28	b	
90 Wgn D	"	Hindley	"	5	32	a	
91 "	"	Ashton-in-Makerfield	"	5	4	a	
92 "	"	Golborne	"	5	72	a	
93 "	"	"	"	5	63	a	
94 "	"	"	"	5	118	a	
95 "	"	"	"	7	33	a	
307 SL D	17 Jan.	Heysham	"	5	125	a	
308 "	"	"	"	5	116	a	
309 "	"	Morecambe	Free	5	132	a	
239 Km D	"	Fleetwood	"	6	58	a	
240 "	"	"	"	5	158	a	
241 "	"	Kirkham	Tied	4	38	b	
242 "	"	Fylde (Rural)	Free	5	89	a	
492 PD	"	Rainford	Tied	5	56	a	
493 "	"	"	"	5	153	a	
494 "	"	Whiston (Rural)	Free	5	62	a	
1360 RD	19 Jan.	Littleborough	Tied	4	26	a	
1363 "	"	"	"	4	26	a	
1364 "	"	"	"	6	26	a	
864 GD	21 Jan.	Fulwood	"	4	14	a	
865 "	"	Preston (Rural)	Free	4	75	a	
866 "	"	Garstang (Rural)	"	5	161	a	
867 "	"	"	Tied	5	38	a	
288 Ws D	23 Jan.	Garston	"	6	139	a	
289 "	"	"	"	6	92	a	
290 "	"	"	"	6	28	a	
291 "	"	"	"	6	140	a	
292 "	"	"	"	6	27	a	
904 LBD	24 Jan.	Walton-le-Dale	Free	4	119	a	
293 Ws D	"	Garston	Tied	6	124	a	
294 "	"	"	"	6	153	a	
295 "	"	"	"	6	152	a	
868 GD	28 Jan.	Garstang (Rural)	"	5	113	a	
869 "	"	Preston (Rural)	Free	4	113	a	
247 Km D	"	"	"	5	16	a	
248 "	"	"	Tied	5	14	a	
249 "	"	Fylde (Rural)	"	5	50	a	
250 "	"	Preston (Rural)	"	4	160	b	
79 HBD	"	Padiham	"	5	134	a	
80 "	"	"	"	5	107	a	
871 GD	4 Feb.	Garstang (Rural)	Free	5	15	a	
873 "	"	"	"	5	76	a	
728 By D	6 Feb.	Whitefield	Tied	4	22	a	
729 "	"	"	"	6	136	a	
730 "	"	"	"	4	97	a	
731 "	"	"	"	6	109	a	
324 LD	7 Feb.	Chorley (Borough)	"	4	15	a	
325 "	"	"	"	4	5	a	
253 Km D	11 Feb.	Lytham	Free	5	159	a	
254 "	"	"	Tied	5	163	a	
255 "	"	"	Free	5	2	a	
256 "	"	"	"	5	164	a	
732 By D	"	Heywood (Borough)	Tied	4	25	a	
733 "	"	"	"	6	43	b	
734 "	"	"	Free	4	96	b	
735 "	"	"	Tied	4	43	b	
736 "	18 Feb.	Radcliffe	"	6	150	a	
737 "	"	"	"	4	145	a	
738 "	"	Heywood (Borough)	"	4	137	a	
739 "	"	"	"	4	166	a	
899 Bn D	19 Feb.	Little Hulton	Free	4	165	a	
900 "	"	"	Tied	4	42	a	
877 GD	20 Feb.	Garstang (Rural)	Free	5	16	a	
879 "	"	"	"	5	77	a	
310 SLD	21 Feb.	Lancaster (Rural)	Tied	6	20	b	
313 "	"	"	"	5	21	b	
501 PD	"	Much Woolton	"	5	92	a	
502 "	"	"	Free	5	103	a	
503 "	"	"	Tied	5	89	a	
99 NLD	23 Feb.	Dalton-in-Furness	"	6	158	a	
100 "	"	"	"	5	74	a	
101 "	"	"	Free	7	93	b	
102 "	"	"	Tied	6	159	a	

(a)—Genuine, or free from arsenic.

(b)—Slightly arsenicated, but passable.

(c)—Containing quantity of arsenic injurious to health.

List of Samples of Beer (including Ales, Stouts, &c.—*continued*.)Appendix
No. 10.

Sample Number and Police Division.	Date of Purchase.	Sanitary District.	House "tied" or "free."	Price of beer per quart.	Brewery Distinctive Number.	Result of Analysis. See foot note.	Remarks.
	1901 :			<i>d.</i>			
103 NLD	23 Feb	Dalton-in-Furness	Free	5	127	<i>a</i>	
104 "	"	"	Tied	5	128	<i>a</i>	
105 "	"	Ulverston (Rural)	Free	6	90	<i>a</i>	
106 "	"	"	Tied	5	12	<i>a</i>	
107 "	"	Dalton-in-Furness	"	6	125	<i>a</i>	
108 "	"	Ulverston (Rural)	"	5	12	<i>a</i>	
257 Km D	25 Feb	Preston (Rural)	Free	4½	16	<i>a</i>	
258 "	"	"	"	5	77	<i>b</i>	
259 "	"	Fylde (Rural)	"	5	77	<i>a</i>	
260 "	"	"	"	5	77	<i>b</i>	
261 "	"	Kirkham	Tied	6	38	<i>b</i>	
262 "	"	"	"	6	161	<i>a</i>	
101 SD	"	Crosby	"	5	99	<i>b</i>	
102 "	"	"	"	5	162	<i>a</i>	
103 "	"	"	Free	5	153	<i>a</i>	
104 "	"	"	Tied	5	153	<i>a</i>	
96 Wgn D	"	Ince-in-Makerfield	"	4	104	<i>a</i>	
97 "	"	"	"	4	34	<i>a</i>	
98 "	"	"	"	4	112	<i>a</i>	
99 "	"	"	"	5	163	<i>a</i>	
100 "	"	"	"	5	9	<i>a</i>	
101 "	"	"	"	4	56	<i>a</i>	
88 HBD	27 Feb.	Colne (Borough)	Brewery	—	59	<i>a</i>	

(a) Genuine, or free from arsenic.

(b) Slightly arsenicated but passable.

(c) Containing quantity of arsenic injurious to health.

Appendix
No. 10.TABLE II.
COUNTY OF LANCASTER.

SUMMARY of Beer Samples Analysed and List of Samples of Glucose obtained by the County Police.

Police Division.	Total Samples obtained.	BEER.					GLUCOSE AND INVERT SUGAR.		
		Samples purchased.	Result of Analysis.			Legal proceed- ings instituted.	Samples obtained.	Result of Analysis.	
			Genuine or free from Arsenic.	Slightly Arsenicated but passable.	Contain- ing quantity of Arsenic injurious to health.			Free from Arsenic.	Contain- ing Arsenic.
Lonsdale North -	30	26	19	6	1	-	4	4	-
Lonsdale South -	15	15	9	6	-	-	-	-	-
Garstang - -	24	24	17	1	6	5	-	-	-
Kirkham - -	29	29	20	6	3	2	-	-	-
Blackburn Lower	4	1	1	-	-	-	3	3	-
Blackburn Higher	15	15	7	3	5	3	-	-	-
Church - -	3	2	2	-	-	-	1	1	-
Rossendale - -	11	10	7	3	-	-	1	1	-
Leyland - -	21	7	3	2	2	-	14	14	-
Bolton - -	19	16	12	1	3	3	3	2	1
Bury - -	39	30	22	4	4	3	9	8	1
Rochdale - -	15	11	9	-	2	2	4	3	1
Ashton - under- Lyne.	-	-	-	-	-	-	-	-	-
Manchester - -	62	54	35	13	6	4	8	6	2
Seaforth - -	21	21	10	4	7	-	-	-	-
Ormskirk - -	23	21	18	-	3	-	2	1	1
Prescot - -	17	14	14	-	-	-	3	3	-
Widnes - -	16	16	15	1	-	-	-	-	-
Warrington -	11	10	7	2	1	-	1	1	-
Wigan - -	33	26	24	-	2	-	7	6	1
Total - -	408	348	251	52	45	24	60	53	7

APPENDIX No. 11.

SPOT MAP" OF THE ADMINISTRATIVE COUNTY OF LANCASTER, showing distribution
of cases of, and deaths by, Poisoning by Arsenic in Beer.

APPENDIX No. II.

THESE DOCUMENTS SONT LA PROPRIETE DE LA BIBLIOTHEQUE DE LA VILLE DE MONTREAL
ET NE DOIVENT PAS ETRE PRETES A D'AUTRES

ADMINISTRATIVE COUNTY OF LANCASTER

SPOT MAP

HANDED IN BY DR SARGEANT, SHOWING ASCERTAINED CASES AND DEATHS.
DUE TO THE CONSUMPTION OF ARSENICATED BEER.
UP TO APRIL 3RD 1901.

CASES Shown thus • DEATHS +

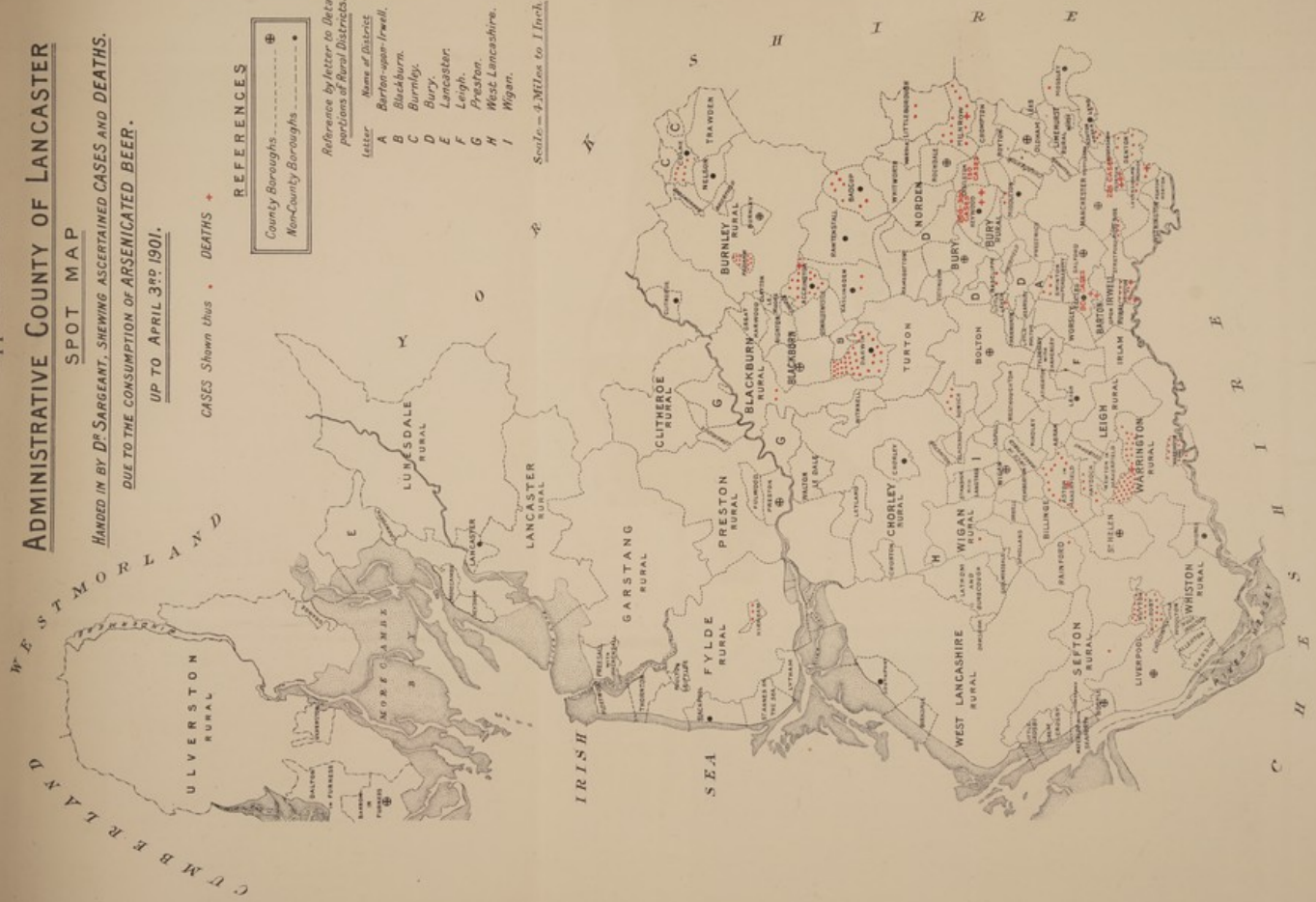
REFERENCES

County Boroughs	-----+-----
Non-County Boroughs	-----•-----

Reference by letter to detached portions of Rural Districts.

Letter	Name of District
A	Barton-upon-Irwell.
B	Blackburn.
C	Burnley.
D	Bury.
E	Lancaster.
F	Leigh.
G	Preston.
H	West Lancashire.
I	Wigan.

Scale = 4 Miles to 1 Inch.



RECEIVED BY THE DIRECTOR OF THE BUREAU OF THE ARMY

1906

RECEIVED BY THE DIRECTOR OF THE BUREAU OF THE ARMY

1906

RECEIVED BY THE DIRECTOR OF THE BUREAU OF THE ARMY

1906

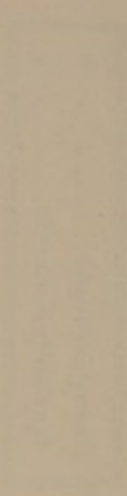


TABLE 1.

TABLE 1. (Continued)

Year	Number of cases	Percentage of total	Notes
1900	100	100	
1901	100	100	
1902	100	100	
1903	100	100	
1904	100	100	
1905	100	100	
1906	100	100	
1907	100	100	
1908	100	100	
1909	100	100	
1910	100	100	
1911	100	100	
1912	100	100	
1913	100	100	
1914	100	100	
1915	100	100	
1916	100	100	
1917	100	100	
1918	100	100	
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1920	100	100	
1921	100	100	
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1930	100	100	
1931	100	100	
1932	100	100	
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2091	100	100	
2092	100	100	
2093	100	100	
2094	100	100	
2095	100	100	
2096	100	100	
2097	100	100	
2098	100	100	
2099	100	100	
2100	100	100	

Appendix
No. 1*TABLE III.
ADMINISTRATIVE COUNTY OF LANCASTER.LIST OF PROSECUTIONS *re* Arsenic in Beer,

No. of Sample.	Name of Vendor.	Price per quart.	Brewery Distinctive Number.	Date of Sample.
1	848 Ernest Ormerod, Duke of Wellington Inn, Bolton Road, Pendlebury.	d. 4	136	1900 : 5 December -
2	871 Lawrence Halliwell, Grapes Inn, Little Lever - -	4	82	4 December -
3	872 Lawrence Halliwell, Grapes Inn, Little Lever - -	6	82	4 December -
4	873 Samuel Wolstencroft, Man and Scythe Inn, Kearsley -	4	69	4 December -
5	227 Thomas Coupe, St. George's Hotel, Kirkham - -	4	161	7 December -
6	1353 John Ed. Eastwood, Royal Oak Hotel, Bowlee, Middleton.	4	55	7 December -
7	68 John Strickland, 1A, Russell Street, Nelson - - -	4½	133	11 December -
8	71 John Strickland, 1A, Russell Street, Nelson - - -	3	133	22 December -
9	855 Frank Lee, Stanley Arms, Liverpool Road, Eccles -	4	163	10 December -
10	704 John Greenhalgh, Printers' Arms, Stubbins Lane, Ramsbottom.	4	67	13 December -
11	651 Thomas Holburt, Black Bear, Ormskirk - - -	5	153	4 December -
12	656 Alice Adair, Junction Hotel, Lathom - - - -	5	153	4 December -
13	706 James Barlow, Crown Inn, Blackburn Street, Radcliffe	4	42	13 December -
14	851 Thomas Hornby Richardson, Horns Inn, Garstang -	5	160	14 December -
15	853 William Gardner, Middle Holly Inn, Cabus, near Garstang.	5	161	18 December -
16	63 Sarah Ann Storr, Derby Arms Hotel, Colne - - -	5	59	4 December -
17	1354 William Taylor, Dyers' Arms, Whitelees Road, Littleborough.	4	26	20 December -
18	858 Edward Hurling, Prince Albert Hotel, Fulwood - -	4	14	1901 : 2 January -
19	233 Peter Critchley, Saddle Inn, Lea - - - - -	5	160	7 January -
20	860 Thomas Metcalf, White Horse Inn, Myersecough - -	5	160	8 January -
21	861 James Bell, Golden Ball, Broughton - - - - -	4	113	8 January -
22	711 George Holt, Freemasons' Arms Hotel, Market Place, Heywood.	4	121	14 January -
23	881 Victoria Entwistle, Coach and Horses Inn, Bolton Road, Pendlebury.	4	171	10 January -
24	884 Levi Rushton, Albert Inn, Bolton Road, Pendlebury -	3	142	10 January -
25	152 Edmund Goddard, Daisy Field Inn, Keb Lane, Bardsley, Ashton-under-Lyne.	—	176	11 March -

TABLE III.

ADMINISTRATIVE COUNTY OF LANCASTER

Appendix
No. 11.

under Section 6 of the Food and Drugs Act, 1875.

Result of Analysis.	Date and Place of hearing.	Result of Prosecution.	Remarks.
1901 :			
Sample contains arsenic ($\frac{1}{10}$ th grain per gallon).	18 January - Strangeways. Decision, 20 January.	Dismissed by Mr. Yates (Stipendiary) on the grounds that summons should have been under Section 3 and not Section 6.	Bostock's glucose used.
Sample contains arsenic ($\frac{1}{10}$ th grain per gallon).	21 January - Bolton.	Withdrawn after conviction on sample No. 872.	Bostock's glucose used.
Contains much arsenic ($\frac{1}{10}$ th grain per gallon).	21 January - Bolton.	Fined 5 <i>l</i> . and costs. (Case stated on insufficiency of certificate, but appeal abandoned.)	Bostock's glucose used.
Contains much arsenic ($\frac{1}{10}$ th grain per gallon).	21 January - Bolton.	Fined 5 <i>l</i> . and costs. (Case stated on insufficiency of certificate, but appeal abandoned.)	Certificate of purity on barrel. Brewers have used Bostock's glucose, but not in this brew.
Contains serious quantity of arsenic ($\frac{1}{10}$ th grain per gallon).	6 February - Kirkham.	Fined 5 <i>l</i> . and costs. (Case stated on insufficiency of certificate.)	Bostock's glucose used.
Sample contains arsenic ($\frac{1}{10}$ th grain per gallon).	7 February - Middleton.	Adjourned, pending decision of higher Court.	Glucose from Brooks, Shudehill, Manchester.
Sample contains arsenic ($\frac{1}{10}$ th grain per gallon).	16 February - Nelson.	Fined 3 <i>l</i> . and costs.	Bostock's glucose previously used, but returned stock on 30th November. Had certificate of freedom from arsenic.
Approximately $\frac{1}{10}$ th grain arsenic per gallon	16 February - Nelson.	Fined 3 <i>l</i> . and costs.	Bostock's glucose previously used, but returned stock on 30th November. Had certificate of freedom from arsenic.
Sample contains arsenic ($\frac{1}{10}$ th grain per gallon).	28 January - Eccles.	Fined 5 <i>l</i> . and costs. (Case stated on insufficiency of certificate. Appeal proceeding.)	Bostock's glucose used.
Contains small quantity of arsenic ($\frac{1}{10}$ th grain per gallon).	31 January - Bury.	Dismissed on the ground that certificate of analyst was insufficient. Case granted. Appeal proceeding.	Brewed from malt and hops only.
Contains small quantity of arsenic ($\frac{1}{10}$ th grain per gallon).	1 February - Ormskirk.	Fined 5 <i>l</i> . and costs. (Case stated on the grounds that summons should have been issued under Section 3. Appeal abandoned.)	Brewers have used Bostock's glucose, but not in this brew.
Contains small quantity of arsenic ($\frac{1}{10}$ th grain per gallon).	1 February - Ormskirk.	Adjourned pending decision of higher Court. (If against, defendant will plead guilty.)	Brewers have used Bostock's glucose, but not in this brew.
Contains serious quantity of arsenic ($\frac{1}{10}$ th grain per gallon).	18 February - Radcliffe.	Fined 20 <i>s</i> . and costs. (Case stated on insufficiency of certificate. Appeal proceeding.)	Bostock's glucose used.
Contains serious quantity of arsenic ($\frac{1}{10}$ th grain per gallon).	14 March - Garstang.	Fined 20 <i>s</i> . and costs.	Bostock's glucose used.
Contains serious quantity of arsenic ($\frac{1}{10}$ th grain per gallon).	14 March - Garstang.	Fined 20 <i>s</i> . and costs.	Bostock's glucose used.
Contains serious proportion of arsenic ($\frac{1}{10}$ th grain per gallon).	25 February - Colne.	Fined 20 <i>s</i> . and costs.	Bostock's glucose used.
Contains $\frac{1}{10}$ th grain arsenic per gallon.	13 March - Rochdale.	Court sent sample to Somerset House. At re-hearing case dismissed on the ground of improper division of the sample.	Brewed from malt and hops. Somerset House find $\frac{1}{10}$ th grain.
Approximately $\frac{1}{10}$ th grain arsenic per gallon.	16 March - Preston.	Court sent sample to Somerset House. Subsequently case withdrawn, defendant to pay costs.	Brewed from malt and hops. Somerset House find $\frac{1}{10}$ th grain.
Approximately $\frac{1}{10}$ th grain arsenic per gallon.	9 February - Preston.	Fined 40 <i>s</i> . and costs.	Brewers have used glucose (Bostock's), but not in this brew.
Approximately $\frac{1}{10}$ th grain arsenic per gallon.	14 March - Garstang.	Fined 20 <i>s</i> . and costs.	Brewers have used glucose (Bostock's), but not in this brew.
Approximately $\frac{1}{10}$ th grain arsenic per gallon.	9 February - Preston.	Fined 40 <i>s</i> . and costs.	Brewed from malt and hops only.
$\frac{1}{10}$ th grain arsenic per gallon.	20 February - Heywood Borough.	Fined 40 <i>s</i> . and costs.	Bostock's glucose used.
$\frac{1}{10}$ th grain arsenic per gallon.	26 February - Strangeways.	Adjourned pending decision of higher Court.	Brewed from malt and hops only.
$\frac{1}{10}$ th grain arsenic per gallon.	26 February - Strangeways.	Adjourned pending decision of higher Court.	Brewed from malt and hops only.
$\frac{1}{10}$ th grain arsenic, calculated as arsenious oxide, per gallon.	—	Prosecution pending.	—

Appendix
No. 12.

APPENDIX No. 12.

TABLES HANDED IN BY PROFESSOR DELÉPINE.

TABLE I.—BEER.

No. of Sample.	Date.	Origin.	Character and Remarks.	Arsenic estimated as Arsenious Acid.		Quantity of material used for Analysis.		Remarks.
				Parts per 10,000,000 Weight.	Grains per Gallon Approximately.	Minimum CC's.	Maximum CC's.	
A	1900. Nov. 16	Brewery A*	Brown - - -	20 to 30	0.17	$\frac{1}{4}$	50	200
B	" 19	" A*	Brown - - -	30 to 40	0.24	$\frac{1}{4}$	25	500
C	" 19	" A*	—	About 40	0.28	Over $\frac{1}{4}$	25	200
63	" 29	" H*	Pale brown, clear (4d.)	4 to 5	0.033	$\frac{1}{16}$	—	200
64	" 29	" H*	Pale brown, clear (6d.)	7	0.049	$\frac{1}{16}$	—	200
65	" 29	" H*	Pale brown, clear (Bitter.)	10	0.070	$\frac{1}{16}$	—	200
66	" 30	" C*	Slightly turbid and sour.	5 to 7	0.042	$\frac{1}{16}$	—	150
67	" 30	" F*	Pale brown, turbid	5	0.035	$\frac{1}{16}$	—	150
68	" 30	" J	" " "	3 to 5	0.028	$\frac{1}{16}$	—	150
69	" 30	" H*	Somewhat turbid	5 to 10	0.049	$\frac{1}{16}$	—	150
70	" 30	" K	" " "	Trace	—	—	—	150
71	" 30	" A*	—	20	0.14	$\frac{1}{4}$	—	150
72	" 30	" E*	—	120	0.84	$\frac{1}{4}$	—	150
73	" 30	" L*	—	10	0.070	$\frac{1}{16}$	—	150
74	" 30	" M*	—	5	0.035	$\frac{1}{16}$	—	150
75	" 30	" N	—	0?	—	—	—	150
76	Dec. 8	" A	From malt and hops	1 to 5	0.021	$\frac{1}{16}$	—	200
77	" 8	" A	Malt and hops	2	0.014	$\frac{1}{16}$	—	200
78	" 8	" A	Stout	1 to 5	0.021	$\frac{1}{16}$	—	200
95	" 26	" F	Made with malts 93, 94, 97, 98 (Table II.) blended.	2	0.014	$\frac{1}{16}$	—	100
96	" 26	" F	<i>Id.</i>	5	0.035	$\frac{1}{16}$	—	100
IX.	" 1	Private *	—	220	1.54	$1\frac{1}{2}$	—	18
II.	Nov. 23	Munich	Dark lager	0	—	0	100	1,000
I.	" 23	Vienna	Light lager	0	—	0	—	100

* Breweries used Bostock Sugars.

N.B.—In the column headed parts per 10,000,000, the actual results of analyses are given; when only one figure is given the quantity recorded may be considered as correct within less than $\frac{1}{16}$ grain, when two figures are given the estimation is somewhat less accurate. The quantities in grains per gallon and per pound have been calculated from the amount estimated in parts per 10,000,000, only the mean being given when two extremes are given in the first column. The estimates in vulgar fractions are the least accurate, owing to the necessity of simplifying some unwieldy fractions.

TABLE II.—MALT.

No. of Sample.	Date.	Origin.	Special Marks.	Character and Remarks.	Arsenic estimated as Arsenious Acid.		Quantities of Material used for Analysis.		Maximum possible amount introduced in Beer brewed entirely from Malt (supposing 1 part of Malt to 4 parts of Beer).	Remarks.
					Parts per 10,000,000 weight.	Grains per pound approximately	Minimum Grammes.	Maximum Grammes.		
28	1900. Nov. 23	Brewery A	26	—	0	—	—	15	Grains per Gallon. —	
29	" 23	" A	27	—	3	0.0021	$\frac{1}{4}$	15	30	$\frac{1}{12}$
30	" 23	" A	28	—	0	—	—	15	—	
31	" 23	" A	29	—	3.3	0.0023	$\frac{1}{4}$	15	30	$\frac{1}{12}$
32	" 23	" A	30	—	0	—	—	15	—	
33	" 23	" A	31	—	Over 3	0.0025	$\frac{1}{4}$	—	15	$\frac{1}{12}$
34	" 23	" A	32	—	0	—	—	15	—	
79	Dec. 21	" O	5	Collected on 21st November.	10 to 12.5	0.0077	$\frac{1}{4}$	—	40	$\frac{1}{2}$
80	" 21	" O	6	" "	2	0.0014	$\frac{1}{4}$	—	40	$\frac{1}{12}$
81	" 21	" O	7	" "	2	0.0014	$\frac{1}{4}$	—	40	$\frac{1}{12}$
82	" 21	" O	8	" "	3.5	0.0025	$\frac{1}{4}$	—	30	$\frac{1}{12}$
83	" 21	" P	2	—	16.5 to 33	0.0175	$\frac{1}{2}$	—	30	$\frac{1}{2}$
84	" 21	" F	13	—	16	0.0112	$\frac{1}{2}$	—	30	$\frac{1}{2}$
85	" 21	" F	14	—	5	0.0035	$\frac{1}{4}$	—	30	$\frac{1}{12}$
86	" 21	" F	15	—	3.3	0.0023	$\frac{1}{4}$	—	30	$\frac{1}{12}$
87	" 21	" F	16	—	3.3 to 16.5	0.007	$\frac{1}{4}$	—	30	$\frac{1}{2}$
88	" 21	" F	17	—	About 3.3	0.0023	$\frac{1}{4}$	—	30	$\frac{1}{12}$
89	" 21	" N	44	—	4 to 20	0.0084	$\frac{1}{4}$	—	25	$\frac{1}{2}$
90	" 21	" N	45	—	About 8	0.0056	$\frac{1}{4}$	—	10	$\frac{1}{2}$
91	" 21	" N	46	—	" 10	0.007	$\frac{1}{4}$	—	25	$\frac{1}{2}$
92	" 21	" N	47	—	" 20	0.014	$\frac{1}{2}$	—	30	$\frac{1}{2}$
93	" 26	" F	—	Horncastle New Black. (See Beers 95 and 96.)	" 5	0.0035	$\frac{1}{4}$	—	30	$\frac{1}{12}$
94	" 26	" F	—	Soames Californian. (See Beers 95 and 96.)	" 2	0.0014	$\frac{1}{4}$	—	30	$\frac{1}{12}$
97	" 26	" F	—	Old Black. (See Beers 95 and 96.)	" 16	0.0112	$\frac{1}{2}$	—	30	$\frac{1}{2}$
98	" 26	" F	—	Old Plain Strong Workop. (See Beers 95 and 96.)	16 to 23	0.013	$\frac{1}{2}$	—	30	$\frac{1}{2}$
99	1901. Jan. 8	" F	0	Dried with new fuel.	3.3	0.0023	$\frac{1}{4}$	—	30	$\frac{1}{12}$
115	" 23	Maltsters Z	—	Modern Kiln.	Trace ?	—	—	30	100	
116	" 23	" Z	—	"	Trace ?	—	—	30	100	

Appendix
No. 12.

TABLE III.—HOPS.

No. of Sample.	Date.	Origin.	Character and Remarks.	Arsenic estimated as Arsenious Acid.			Quantity of material used for analysis. Grammes.	Maximum possible amount introduced into a Gallon of Beer on the supposition that 1 % Hops is used.	Remarks.
				Parts per 10,000,000 weight.	Grains per pound approximately.				
	1900.							Grains per Gallon.	
1	Nov. 21	Brewery P	Pale yellow, good aroma	0?	-	-	5	0	
2	"	" O	Pale green, aroma slight	0?	-	-	5	0	
3	"	" O	Yellow, aroma strong	5 to 10	0.005	$\frac{1}{16}$	10	$\frac{1}{16}$	
4	"	" F	Aroma strong	5 " 10	0.005	$\frac{1}{16}$	10	$\frac{1}{16}$	
5	"	" F	Yellow green, sour	5 " 10	0.005	$\frac{1}{16}$	10	$\frac{1}{16}$	
6	"	" F	Aroma slight	5 " 10	0.005	$\frac{1}{16}$	10	$\frac{1}{16}$	
7	"	" F	Greenish, aroma strong	Trace	-	-	5	-	
8	"	" A	Yellow and greenish, aroma slight.	"	-	-	5	-	
9	"	" A	Greenish yellow, aroma faint.	5 to 10	0.005	$\frac{1}{16}$	5	$\frac{1}{16}$	
10	"	" A	Brownish yellow, aroma slight.	10 " 20	0.010	$\frac{1}{16}$	5	$\frac{1}{16}$	
11	"	" A	Yellow, aroma slight	0	-	-	5	-	
12	"	" A	Pale yellow, aroma moderate.	0	-	-	5	-	
13	"	" N	Greenish yellow, aroma moderate.	About 10	0.007	$\frac{1}{16}$	10	$\frac{1}{16}$	
14	"	" N	Brownish yellow, aroma slight.	0	-	-	10	-	
15	"	" N	Brownish yellow, aroma slight.	About 10	0.007	$\frac{1}{16}$	10	$\frac{1}{16}$	
16	"	" N	Greenish yellow, aroma moderate.	0	-	-	10	-	
17	"	" N	Brownish yellow, aroma slight.	0?	-	-	10	-	
18	"	" N	Greenish yellow, aroma slight.	5 to 10	0.005	$\frac{1}{16}$	10	$\frac{1}{16}$	
19	"	" N	Yellowish, aroma slight	0	-	-	5	-	
20	"	" N	Brownish yellow, aroma very slight.	About 10	0.007	$\frac{1}{16}$	10	$\frac{1}{16}$	

TABLE IV.—BREWING SUGARS.—GLUCOSE.

Appendix
No. 12.

No. of Sample.	Date.	Origin.	Character and Remarks.	Arsenic estimated as Arsenious Acid.		Quantities of Material used for Analysis.		Maximum possible amount introduced into a gallon of beer, on the supposition that only 5 per cent. sugar is used.		Remarks.	
				Parts per 10,000,000 weight.	Grains per pound approximately.	Minimum Grammes.	Maximum Grammes.	Grains per gallon.			
	1900.										
21	Nov. 22	Brewery A	Yellowish	0	—	—	—	10	—	—	Tested by Marsh gives a good arsenical mirror.
22	" 22	" A	Deep Brown	0	—	—	—	10	—	—	
23	" 22	" A*	Yellow	6,000	4.2	4½	—	10	2.1	2½	
24	" 23	" O	Pale Yellow	10	0.007	1½	—	15	0.0035	4½	
37	" 23	" P	Pale Yellowish Brown.	7	0.005	1½	—	15	0.0025	4½	
38	" 23	" N	Pale Yellowish Brown.	0?	—	—	—	15	—	—	
39	" 23	" N	Pale Yellowish Brown.	0?	—	—	—	15	—	—	
44	" 23	Bostock*	Dark Brown (compact).	9,500	6.65	6½	0.010	15	3.3	3½	
45	" 23	" *	Yellowish White.	Ab. 1,500	1.05	1½	0.20	15	0.5	½	
46	" 23	" *	White	Ab. 1,500	1.05	1½	0.20	15	0.5	½	
47	" 23	" *	Pale Yellow	Ab. 5,000	3.5	3½	0.02	15	1.7	1½	
48	" 23	" *	Brownish Yellow.	6,000	4.2	4½	0.016	15	2.1	2½	
49	" 23	" *	Dark Brownish Yellow.	4,000	2.8	2½	0.025	15	1.4	1½	
62	" 29	Confect'ner	Glucose solution containing also S O ²	0	—	—	10	15	—	—	

INVERT SUGAR.

									Supposing 5 per cent. used as substitute.	Supposing 0.15 per cent. used for priming.	Total.	
25	Nov. 23	Brewery O	Honey-like solution.	0?	—	—	—	20	—	—	—	
26	" 23	" A*	Syrupy solu- tion contain- ing 36 per cent. solid. Arsenic esti- mated in the solid invert.	800	0.56	$\frac{5}{8}$	0.125	40	0.28	$\frac{7}{8}$	0.008	0.288
40	" 23	" F*	Crystallised honey-like, solid not esti- mated.	2,000	1.4	$1\frac{1}{2}$	0.125	15	0.70	$\frac{7}{16}$	0.021	0.72
41	" 23	" F	Honey-like pale yellow, solid not estimated.	7	0.005	$\frac{7}{16}$	—	15	0.0025	$\frac{1}{16}$	0.000075	0.0025
50	" 23	Bostock	Semi-fluid, honey-like pale yellow, solid not esti- mated.	1,430	1	1	0.07	15	0.5	$\frac{1}{4}$	0.015	0.515
51	" 23	"	Greyish yellow, slightly more solid than 50.	2,000	1.4	$1\frac{1}{2}$	0.05	15	0.7	$\frac{7}{16}$	0.021	0.721

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TABLE V.—YEAST.

No. of Sample.	Date.	Origin.	Character and Remarks.	Arsenic estimated as Arsenious Acid.		Quantities of Material used for Analysis.		Remarks.
				Parts per 10,000,000 weight.	Grains per pound approximately.	Minimum Grammes.	Maximum Grammes.	
106	1901. Jan. 14	Brewery F	Yeast in use on 14 Jan. 1900.	6.6	0.0046	$\frac{1}{175}$	—	30
107	" 14	" A	Yeast in use on 14 Jan. 1900.	20	0.014	$\frac{1}{75}$	—	30
XIV.	Feb. 8	" B	Yeast in use on 31 Dec. 1900.	82	0.0574	$\frac{1}{17}$	—	30
XIII.	" 8	" B	Yeast in use on 15 Jan. 1901.	100	0.07	$\frac{1}{14}$	—	30

TABLE VI.—MATERIAL OTHER THAN MALT, HOPS, YEAST, AND SUGAR
USED IN BREWING.

No. of Sample.	Date.	Origin.	Character and Remarks.	Arsenic estimated as Arsenious Acid.		Quantity of Material used for Analysis.		Remarks.
				Parts per 10,000,000 weight.	Grains per lb. approximately.	Minimum Grammes.	Maximum Grammes.	
27	1900. Nov. 23	Brewery A	Water	0	—	—	—	200
35	" 23	" A	Gypsum (white powder)	0	—	—	—	15
57	" 29	" F	"	7	0.005	$\frac{1}{200}$	—	15
36	Nov. 23	Brewery A	Preservative (Sulph. of potash).	0	—	—	—	10
58	" 29	" F	Clear fluid, smell of SO ₂ (Sulph. or bisulph. of potash.)	45	0.0315	$\frac{1}{32}$	25	40
59	Nov. 29	Brewery F	Isinglass, turbid fluid	0	—	—	—	40

TABLE VII.—PREPARATION OF MALT.

No. of Sample.	Origin.	Special Marks.	Character and Remarks.	Arsenic estimated as Arsenious Acid.			Quantity of material used for Analysis.		Maximum amount introduced into a Gallon of Beer (See Malt grains).	Remarks.
				Parts per 10,000,000 weight.	Grains per pound approximately.		Minimum Grammes.	Maximum Grammes.		
117	Maltster X	1	Clean, pale, full-grown barley.	0?	—	—	—	100	0	
118	"	2	—	0	—	—	—	100	0	
119	"	3	Dark and poor in appearance.	Trace?	—	—	—	100	0	
120	"	4	Dark and poor	0?	—	—	—	100	0	
121	"	5	Clean, pale, full-grown.	Trace?	—	—	—	100	0	Kiln dried.
122	"	6	Intermediate appearance.	Trace?	—	—	—	100	0	Kiln dried.
100	Maltster Y	—	Malt ready for kiln drying.	0?	—	—	—	30	0	
101	"	—	Culms from old fuel	132	0.0924	$\frac{1}{11}$	—	30	—	
102	"	—	Dust from underneath drying kiln	264	0.1848	$\frac{1}{11}$	—	30	—	
111	Maltster X	—	Malt not screened or polished.	11	0.0077	$\frac{1}{128}$	—	30	$\frac{1}{128}$	
112	"	—	Screened and polished Malt, same as 111.	3.3	0.0022	$\frac{1}{128}$	—	30	$\frac{1}{128}$	
113	"	—	Culms from 111	1,500	1.05	$1\frac{1}{8}$	—	10	—	
114	"	—	Malt dust from 111	4,000	2.8	$1\frac{1}{8}$	—	10	—	
115	Maltster Z	—	Malt from modern kiln.	0?	—	—	—	100	—	Repeated from Malt tables for comparison.
116	—	—	Malt from modern kiln.	0?	—	—	—	100	—	Ditto.

FUEL.

103	Maltster Y	—	Anthracite Coal	5?	0.0035?	$\frac{1}{128}$	—	10	—	
104	"	—	Coke (Gas)	100	0.07	$\frac{1}{128}$	2.5	10	—	
105	"	—	Coke purified	80	0.056	$\frac{1}{128}$	2.5	10	—	
108	Maltster X	—	Anthracite Coal	Small amount.	—	—	—	10	—	Detected by Marsh's test.
109	"	—	Coke (Retort)	2,000	1.4	$1\frac{1}{8}$	0.5	10	—	
110	"	—	Coke	325	0.2275	$\frac{1}{128}$	0.5	10	—	

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TABLE VIII.—MATERIAL USED IN THE PREPARATION OF BREWING SUGARS.

No. of Sample.	Date.	Origin.	Character and Remarks.	Arsenic estimated as Arsenious Acid.			Quantity of Material used for Analysis.		Remarks.
				Parts per 10,000,000 weight.	Grains per lb. approximately.		Minimum Grammes.	Maximum Grammes.	
RAW MATERIAL :									
52	1900. Nov. 23	Bostock	Maize Meal - - -	0	—	—	—	15	
53	"	"	Sago Flour, brown mixed with woody fibre -	0	—	—	—	15	
54	"	"	Tapioca Flour, greyish white, lumpy.	0	—	—	—	15	
55	"	"	Cane sugar, brown soft.	0	—	—	—	15	
ACID FOR CONVERTING :									
42	Nov. 23	Bostock	Sulphuric Acid, B.O.V., very dark, cloudy, white deposit, Sp. gr., 1.73.	145000	101.5	—	0.00066	2	Two drops tested by Marsh's method gave a good arsenical mirror. White precipitate con- tains a very large amount of arsenic es- timated by ordinary gravimetric method— more than 3.10 per cent. QUALITATIVE TESTS : = Traces of lead. " " calcium. An appreciable amount of iron. No selenium.
ACID USED FOR BLEACH- ING :									
43	Nov. 23	Bostock	Sulphurous Acid - -	10 (in vol.)	0.007	11½	40	45	
CARBONATE OF CAL- CIUM USED FOR NEU- TRALISING :									
56	Nov. 23	Bostock	Whiting - - -	0	—	—	—	10	
CHARCOAL USED FOR DECOLOURISING AND PURIFYING :									
60	Nov. 23	Bostock	Charcoal before Re- burning.	9000 (About)	6.3	6½	—	15	
61	"	"	Charcoal after Re- burning.	8000	5.6	5½	—	15	

TABLE IX.—ARSENIC IN THE BODY OF A BEER DRINKER.

Date.		Arsenic estimated as Arsenious Acid.		Quantity of Material used for Analysis.		Remarks.
		Parts per 10,000,000 weight.	Quantity of Arsenic contained in 3 lbs. of urine, i.e., per diem in grains.	Minimum Grammes.	Maximum Grammes.	
1900. Dec. 24	Urine from patient suffering from arsenical poisoning due to drinking Salford beer.	1.2	0.00252	1½	—	150

TABLE IX.A.

FUEL.

	Material.	Parts per 10,000,000, about.	Grains per pound.	Quantity of Material used.
M 32	Soot deposited in flue of a chimney after burning good house coal (South Yorkshire Colliery) for one week - Flue cleaned once a week.	8,000	5.6	Grammes. 0.5
M 33	Soot deposited in flue of a closed stove, after burning Corporation Gas Works Coke for 15 days - Flue cleared once in a fortnight, the amount of soot obtained weighing about 113 grammes. This amount contains about half a gramme of arsenious acid.	40,000	28	0.025
M 34	Soot produced by a single gas jet (Manchester gas) burning for 3 hours and a half (combustion in confined space). Water produced during combustion added to the soot - No appreciable amount of gaseous compound of arsenic appears to be present in gas manufactured from coals from which the above coke was obtained (M 33), i.e., in purified gas as supplied to the consumer.	0 (?)	—	0.41

DISSEMINATION OF ARSENICAL SOOT THROUGH THE AIR.

M 40	A. Leaves of evergreen shrubs (laurels, rhododendrons, ivy, holly), collected in a garden in Victoria Park (Manchester), leaves blackened by soot selected. There had been much rain for several days previous to the collection of the leaves Thirty grammes of leaves represent an area of about 1,044 sq. c.m. B. Soot washed from the surface of 50 grammes of leaves (it was impossible to remove all the soot) It was not possible to clean the leaves sufficiently completely to estimate what amount of arsenic (if any) had penetrated into the tissues of the leaves. C. Leaves of evergreen shrubs (laurels, ivy), collected in Streatham, near London, in a garden surrounded by large gardens and fields. There had been rain for several days. Old leaves were selected but no special care was taken to obtain only those covered with soot D. Leaves of evergreen shrubs (laurels, ivy), collected in a small town garden in Montreux, Switzerland. The garden was surrounded by houses. There had been rain for several days. The oldest and most dusty leaves were selected, but none showed any evidence of the presence of soot. The town is very small. Of late coal fires have been used, but wood is still the chief combustible	4 2 under 0.5 0 (?)	— — — —	Grammes. 30 50 50 50
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COMBUSTION OF TOBACCO.

M 39	Products of combustion of half ounce of tobacco, obtained by bubbling slowly the smoke through water. No appreciable trace of arsenic was found This experiment and the one on gas soot may be looked upon as control experiments for comparison with the others.	0	—	Grammes. —
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Appendix
No. 12.TABLE X.—GENERAL RESULTS OF AUTOPSIES OF FATAL CASES OF
ARSENICAL POISONING.

To Professor Sheridan Delépine—In accordance with your request, I beg to submit the following information on the points specified by you as determined by autopsies on cases of "Arsenical Beer Poisoning."

No.	Sex.	Age.	Nutrition.	Associated Diseases.	
1	M.	53	Fair. No marked wasting of muscles.	Pulmonary tuberculosis.	Tuberculosis of pleurae and peritoneum.
2	F.	46	Emaciated. Marked wasting of muscles.	Pulmonary tuberculosis with cavitation.	Tuberculosis of pleurae and peritoneum.
3	M.	31	Well nourished. No muscular wasting.	Pulmonary tuberculosis "consolidation."	General miliary tuberculosis.
4	F.	53	Fair. Muscles of extremities wasted.	Old tuberculosis at apices, recent pneumonia.	Tuberculosis of pleurae, peritoneum, liver and kidneys.
5	F.	30	Fair. Muscles of extremities wasted.	Pulmonary tuberculosis with cavitation.	Tuberculosis of pleurae and peritoneum.
6	M.	50	Fair. Muscles of legs wasted.	Extensive tuberculous broncho-pneumonia.	Tuberculosis of pericardium, pleurae, peritoneum, liver, spleen and kidneys.
7	M.	44	Emaciated. Muscles of limbs much wasted.	Pulmonary tuberculosis not advanced nor extensive.	Tuberculosis of pleurae and peritoneum.
8	M.	40	Well nourished. No muscular wasting.	Pneumonia (?) tuberculous.	Tuberculosis of pleurae and peritoneum.
9	F.	(?)	Emaciated. Muscles of extremities much wasted.	Hypostatic pneumonia.	—
10	F.	42	Emaciated. Muscles of extremities wasted.	Pulmonary tuberculosis with cavitation.	Tuberculosis of pleurae and peritoneum.
11	F.	34	Fair. Muscles of legs wasted.	Hypostatic pneumonia.	—
12	F.	(?)	Emaciated. Muscles of limbs wasted.	Pulmonary tuberculosis, not advanced.	—
13	F.	54	Fat. Muscles of extremities little wasted.	Broncho-pneumonia, old foci of tuberculosis in lungs.	—

In addition, it may be stated that typical periaxial degeneration of the peripheral nerves, varying in degree, has been found in such of the above cases as have been examined, viz., cases 1 to 12 inclusive. The livers in many of the cases presented irregularly-distributed congestion, degeneration, and varying degrees of cirrhosis. Further the skin in many of the cases was pigmented in varying degrees.

F. CRAVEN MOORE, M.Sc., M.D.,
Assistant Lecturer in Pathology and Morbid Anatomy,
Pathological Department, Owens College.

TABLE XI.

INTERIM REPORT of Dr. FRANCIS J. H. COUTTS on the PRESENCE OF ARSENIC IN FOOD PRESERVATIVES, &c.

Reference Number.	Material.	Arsenic as As_2O_3 in parts per 10,000,000.	Arsenic in grains per pound, approximately.	Weight used.
M 129	English shrimps, in paper package	2	1-700th.	Grammes. 100
M 128	"German" shrimps, in paper package, in cardboard box along with M 129. Said to be German, imported to be sold as English	About 13	1-100th.	100
M 127	"Pure English" shrimps, said not preserved (a specimen received later than M 129)	2	1-700th.	100

Materials possibly used in Preservation of Food Stuffs.

M 121	Nitre (such as was formerly used for preserving pathological specimens)	15	1-90th.	Grammes. 15
M 114	Potassium nitrate (bought from drysalter)	Trace	—	15
M 120	Borax (bought from grocer)	50 to 60	1-28th to 1-23rd.	15
M 112	"Refined borax" (drysalter)	7	1-180th.	15
M 119	Boracic acid (from druggist)	—	—	15
M 113	Boracic acid (drysalter)	Trace	—	15
M 118	Common salt (household)	—	—	15
M 117	Freezing salt	Trace	—	15
M 111	"Bay" salt (drysalter)	Trace	—	15

Other Chemicals.

M 116	Sodium sulphate	2 to 3	1-700th to 1-500th.	Grammes. 15
M 115	Sodium carbonate (crystals)	6	1-240th.	15
—	"Pure" hydrochloric acid ("redistilled")	Trace	—	100cc.

By FRANCIS J. H. COUTTS, M.D., D.P.H., F.C.S.,
Assistant in the Bacteriological Laboratory,
Pathological Department, Owens College.

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J. Clouet (Annales d'Hygiène Publique 1878, p. 145), in searching for the source of the arsenic sometimes present in wine, found that fuchsin is often incriminated wrongly, but that the caramel which is frequently used in conjunction with fuchsin often contains a large amount of the poison. Ritter had previously shown this to be the case. These two observers found that the arsenic is derived from impure sulphuric acid which is not infrequently used in the preparation of glucose from which caramel is made. Arsenic is always more or less abundant in sulphuric acid prepared from arsenical pyrites. In addition to arsenic, glucose frequently contains a large proportion of free sulphuric acid, this being the effect of imperfect neutralisation of the acid after conversion of starchy matters. The results of Clouet's and of Ritter's analyses may be tabulated as follows:—

TABLE XII.

ANALYSES of ARSENICAL PYRITES, SULPHURIC ACID, and GLUCOSE, by Professor CLOUET and Professor RITTER.

Substance.	Source.	Observer.	Arsenious Acid, in grammes per kilogram.	Arsenious Acid.	
				Parts in 10,000,000.	Grains per lb.
Pyrites .	Siegen (Westphalia)	Clouet . .	0.026	260	0.182
	Chessy, near Lyons (France) . .	" . .	0.00022	2.2	0.00154
Sulphuric Acid .	Fabrique des Vosges	Clouet . .	Max. 1.80	18,000	12.6
		Ritter . .	Min. 0.59	5,900	4.13
Glucose	† Luneville (Vosges)	Clouet . .	Max. 0.009	90	0.063
			‡ Mean 0.0066	66	0.0462
			Min. 0.0033	33	0.0231
	La Briche (near Paris)	" . .	Slight trace.	—	—
	† Aubervilliers	" . .	Traces unweighable.	—	—
	† Bourget	" . .	0	—	—
	† Rueil	" . .	0	—	—
	German Glucose, white	Ritter . .	0.013	130	0.09
	" " yellow	" . .	0.022	220	0.154
	" " dark	" . .	0.1438	1,438	1.006

Free Sulphuric Acid in Glucose.

Glucose	Luneville (Vosges)	Clouet . .	Max. 4.980	—	34.860
			‡ Mean 2.716	—	19.012
			Min. 1.327	—	9.273

Calculated Amount of Arsenic that might be introduced in Beer Brewed from Arsenical Glucose.

Beer					Grs. per gal.	
Beer	From White Glucose	Ritter . .	0.00050	5	0.035	$\frac{1}{8}$
	" Black	" . .	0.00547	54.7	0.38	1

* In this table the arsenic has been given as arsenious acid, and the quantities found in 10,000,000 and per lb. have been calculated from the figures given in the original paper, in which the poison is estimated as *arsenicum*.

† Process of manufacture the same, but sulphuric acid used different.

‡ Mean of all the analyses made by the observer, including maxima and minima.

TABLE XIII.

QUANTITY of ARSENIC found in various MINERAL WATERS. (Q. 5309.)

Name of Spa.	Country.	Arsenical Compound.	Authority.	Quantity in parts.	
				Per 1,000.	Per 7,680.
Baden-Baden - - - - -	Germany.				
Murquelle - - - - -	—	Arsenate of Iron -	Bunsen - -	Trace.	—
Fettquelle - - - - -	—	" - - - -	" - - - -	—	0.0038
Bourboule - - - - -	France.				
Choussy - - - - -	—	Arsenious Acid -	—	0.0115	—
Perrière - - - - -	—	" - - - -	—	0.0108	—
Contrexéville—Pavilion Spa - -	France -	Arsenic - - -	Debray - -	Trace.	—
Mondorf - - - - -	Luxemburg -	Arsenic Acid -	Kirchoff - -	—	0.001
Rippoldsau - - - - -	Germany.				
Josephquelle - - - - -	—	Arsenic - - -	Bunsen - -	—	Traces.
Leopoldsquelle - - - - -	—	" - - - -	" - - - -	—	"
Vals - - - - -	France.				
Saint Jean - - - - -	—	Arsenate of Soda -	M. Henri -	Traces.	—
Précieuse - - - - -	—	" - - - -	" - - - -	"	—
Desirée - - - - -	—	" " - - -	" - - - -	"	—
Rigolette - - - - -	—	" " - - -	" - - - -	"	—
Magdelaine - - - - -	—	" - - - -	" - - - -	"	—
Vichy - - - - -	France.				
Grande Grille - - - - -	—	Arsenate of Soda -	Bouquet - -	0.002	—
Hôpital - - - - -	—	" " - - -	" - - - -	0.002	—
Célestins - - - - -	—	" " - - -	" - - - -	0.003	—
Hauterive - - - - -	—	" " - - -	" - - - -	0.002	—
Wiesbaden - - - - -	Germany -	Arsenate of Lime -	Fresenius -	—	0.001

Appendix
No. 13.

APPENDIX No. 13.

PAPERS handed in by MR. H. WELD BLUNDELL.

With reference to the proportion of Invert Sugar in use at the Cornbrook Brewery, Mr. Blundell has supplemented his evidence by instances of particular brews at various dates in August and September, 1900, in which the proportions were as follows:—

Date of Brew and Quality of Beer.	Percentage of Invert Sugar to total Materials used.	Pounds weight of Invert Sugar used per Gallon of Beer produced.
3rd August, 1900, Bitter Beer, No. 492 - -	12·06	·14
9th " " Quality C, No. 501 - -	11·94	·14
22nd " "	11·11	·12
5th September, 1900, Quality C.B.B. (Bitter Beer), No. 538 - - -	10·41	·12
20th September, 1900, Stout, No. 560 - -	11·11	·18
28th " " Quality X, No. 569 -	11·11	·12
10th October, 1900, Quality X, No. 113 - -	11·11	·12
2nd November, 1900, Stout, No. 142 - -	11·11	·15
7th " " Bitter Beer, No. 146 -	11·56	·13
15th " " Stout, No. 156 - -	11·11	·15

APPENDIX No. 14.

HAIDED IN BY SIR LAUDER BRUNTON.

Extrait du Bulletin de l'Académie de Médecine, 1888. No. 27. 3^e Série, Tome XX., p. 617.

Sur les communications de MM. VIDAL, MARQUEZ et DUBRANDY, relatives à l'affaire des vins empoisonnés d'Hyères au nom d'une Commission composée de MM. E. VIDAL et

A. OLIVIER, rapporteur.

Vers la fin d'hiver dernier, une maladie bizarre, avec des troubles digestifs, des exanthèmes sans forme déterminée, des accidents nerveux capables de faire songer à une affection de la moelle épinière, se développait dans une partie de la population d'Hyères; elle frappait de préférence des ouvriers et des petits employés, semblant épargner les femmes, les enfants et les classes aisées. Comme les premiers cas étaient peu graves, on n'y prêtait guère attention; à mesure qu'ils devenaient plus nombreux, la population s'émouvait, les médecins échangeaient différentes observations au sujet des malades qu'ils venaient de traiter, et, en fin de compte, en reconnurent de tous les cas de la prétendue maladie, épidémique d'Hyères étaient des cas d'intoxication par l'arsenic.

Toute cette affaire a été l'objet d'une enquête juridique et de débats sur lesquels nous n'avons pas l'intention de revenir. En revanche, l'Académie a reçu des documents intéressants au point de vue de l'étude clinique de l'empoisonnement par l'acide arsénieux administré à doses faibles, répétées, dans un produit alimentaire, le vin.

Le 19 juillet, un premier mémoire renfermant l'observation détaillée et très précise d'un des faits en question lui était adressé par M. le Dr E. Vidal (*De la similitude des symptômes de l'acrodynie et de l'intoxication lente par l'acide arsénieux*). Ce travail contient en outre une analyse bien faite et une discussion très serrée sur la nature même de la maladie. Le 21 juillet

l'Académie recevait un autre mémoire de M. le Dr Marquez (*Acrodynie et arsénisme*) relatif aux mêmes faits: enfin, le 14 août, une étude du Dr Dubrandy (*Contribution à l'étude de l'empoisonnement chronique par l'arsenic*), portant sur une soixantaine de faits, venait s'ajouter aux deux précédents. Tous ces documents ont été renvoyés à une Commission composée de MM. Emile Vidal et Auguste Ollivier, rapporteur. C'est au point de vue de ces travaux très détaillés, consciencieux, irréprochables au point de vue clinique, que je vais essayer d'esquisser l'histoire des faits qui se sont passés à Hyères à la fin de l'hiver 1887 et au commencement du printemps de l'année 1888.

L'hiver en question fut froid rigoureux, accompagné de gripes, dont quelques-unes présentèrent des phénomènes gastro-intestinaux et furent suivies d'un abattement, d'un affaiblissement musculaire plus marqué et plus persistant qu'il ne l'est d'habitude à la suite de l'influenza. A cet égard, la même remarque avait été faite par tous les médecins. Lorsque, plus tard, on eut découvert le *corpus delicti*, tous furent unanimes à déclarer que l'ingestion du vin était probablement pour quelque chose dans les accidents qu'ils avaient auparavant eu l'occasion de noter à diverses reprises. Dès le 8 février, le Dr Vidal donne ses soins à une employée du chemin de fer, présentant les symptômes ordinaires d'un embarras gastrique de moyenne intensité. Ces symptômes s'atténuent sous l'influence du traitement et font place à une diarrhée modérée, mais persistante. Le 4 mars, se montrent sur différents points du corps des taches rouges, prurigineuses, urticariformes, et dont la régression ne suit point la marche que suit d'habitude celle des plaques d'urticaire. Pendant tous le mois de mars différents phénomènes se succèdent irrégulièrement, sans qu'on puisse connaître les connexions pathogéniques qu'ils présentent. Ce sont: un catarrhe des voies respiratoires avec sécrétion peu abondante, mais accompagnée de toux spasmodique et d'accès de dyspnée, une inappétence et une diarrhée persistantes; enfin, le 31 mars, apparaissent les phénomènes paralytiques qui ont existé dans la plupart des cas observés et en ont constitué le caractère le plus frappant. Les jambes sont

le siège de différents troubles sensitifs (douleurs, fourmillements, élancements); les mains sont prises à la tour, et, malgré cela, il y a aux membres supérieurs comme aux membres inférieurs de l'hypéresthésie cutanée, à tel point que le contact des draps ne peut être supporté et que le malade est obligé de sortir presque constamment les pieds du lit; les mouvements sont difficiles, les jambes semblent trop lourdes pour la marche. En présence d'un pareil complexe, M. Vidal arrive à songer à une maladie épidémique, de nature mal connue, observée à plusieurs reprises, mais particulièrement vers 1830 à Paris et dans les environs, à l'acrodynie. Cette idée le conduisit naturellement à penser à l'alimentation des malades, car, malgré l'incertitude qui règne sur la nature de l'acrodynie, malgré le résultat négatif des recherches entreprises aux époques d'épidémie, l'opinion générale qui a toujours persisté relativement à sa nature, c'est que c'était une maladie d'alimentation plus ou moins comparable à l'ergotisme au lathyrisme et à la pellagre.

Des accidents analogues à ceux qu'a décrits M. Vidal étaient notés par tous les médecins d'Hyères; ainsi, du 13 février au 3 avril, M. Dubrandy est appelé par des malades qui tous se plaignent de faiblesse musculaire, de fourmillements, d'une douleur des membres inférieurs, parfois assez vive pour les empêcher de dormir pendant la nuit. Il est probable que, dès le milieu de mars, l'opinion s'était répandue dans le corps médical et même dans la population, que la maladie régnante présentait quelque chose d'anormal, et que, selon toute probabilité, il y avait un élément nocif, inconnu, dans les substances qu'on absorbait d'habitude. L'aspect clinique rappelait si bien une maladie due aux ingesta qu'à une date non précisée, mais certainement antérieure à la découverte de la véritable cause, le Dr Decurgis, soignant plusieurs ouvriers de M. X....., le propriétaire poursuivi plus tard, leur demanda formellement s'ils étaient bien fixés sur la nature du vin qu'ils buvaient. Après leurs protestations unanimes, il abandonna ses soupçons et chercha dans un autre sens.

Ce fut le Dr Charles Roux qui découvrit le premier la véritable cause. Le 4 avril, ce médecin déclarait à la commission d'hygiène d'Hyères que les accidents rapportés soit à l'acrodynie, soit à des gripes anormales, se développaient exclusivement chez des individus buvant un vin de provenance déterminée. Pour faire une pareille déclaration, il avait fallu que la conviction de l'auteur fût étayée sur des faits si probants, qu'à leur égard toute discussion fût superflue. Il ne s'agissait plus, en effet, d'une opinion scientifique, susceptible d'être soutenue ou combattue sans provoquer une vive émotion dans le public. L'opinion de M. Roux contenait une accusation capable de servir de base à une action juridique et d'avoir des conséquences commerciales faciles à prévoir. En fait, il y avait en dans le développement antérieur de la soi-disant épidémie une série de circonstances capables de donner à réfléchir. "Jusqu'au 20 mars, dit le Dr Dubrandy, j'avais toujours supposé que les accidents pourraient bien être d'origine alcoolique et produits par l'usage d'alcools absorbés en nature ou sous forme de vins vinés pris en excès."

La commission d'hygiène se réunit de nouveau le 16 avril. M. Roux renouvelle son accusation en nommant le propriétaire du chai. "Il expose, dit la relation publiée à l'époque, les principaux caractères de l'étrange maladie qui sévit à Hyères en ce moment, et s'élève contre l'opinion de ceux qui prétendent qu'elle n'est autre chose que la grippe." Il y a en, en effet, ajoute-t-il, quelques cas de grippe dans notre ville, mais aucun d'entre eux n'a été observé sur des personnes ayant bu

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des vins de M. X..... Quant aux personnes qu'il traite pour la maladie dont il vient de faire la description, toutes ont usé de ces vins, et c'est à eux seuls qu'elle doit être attribuée. Il termine en demandant à ses collègues s'ils ont observé des symptômes semblables à ceux qu'il a constatés.

Cette manière de voir fut appuyée par le Dr Vidal. Il déclara partager absolument les idées émises par son honorable collègue, le Dr Roux. "Depuis quelques temps, dit-il en effet, les nombreux symptômes de l'acrodynie signalés par les auteurs ont été observés dans la population..... En présence des déclarations de M. Charles Roux, et considérant que l'acrodynie est toujours le résultat d'un état particulier de l'organisme, produit par des aliments de mauvaise qualité, il demande qu'il soit nommé dans le sein du Comité d'hygiène une commission de trois membres chargée de faire une enquête sur les faits développés par M. le Dr Roux." (*Hygiène Journal*, 29 avril 1888.)

Cette mesure fut adoptée à l'unanimité. En même temps des échantillons du vin suspect avaient été envoyés pour l'analyse chimique à M. le Dr Sambuc, à Toulon. Le 17 avril, M. Roux recevait de lui une première communication mentionnant qu'il avait trouvé dans certains échantillons jusqu'à 8 centigrammes d'acide arsénieux par litre. Désormais la phase médico-légale va commencer.

La première phase, la seule qui nous intéresse et dont nous avons relaté brièvement les péripéties, va du mois de février au 4 avril; les cas, en nombre d'abord, augmentent au point d'éveiller l'attention de l'autorité.

Diverses opinions plausibles sont formulées jusqu'à l'époque à laquelle l'intervention du Dr Roux est décisive. C'est précisément pendant cette phase d'étonnement et d'incertitude qu'ont été observés les phénomènes cliniques les plus frappants de l'intoxication.

Comme de pareils faits sont rares, nous allons les passer en revue.

Ceux qui attirèrent surtout l'attention furent :

- 1° Des troubles digestifs ;
- 2° Des éruptions cutanées ;
- 3° Des phénomènes nerveux assez prononcés pour faire songer à une affection médullaire.

Les troubles digestifs, malgré leur fréquence, furent moins importants qu'on ne serait, *a priori*, tenté, de le croire. Le malade de M. Vidal était venu réclamer ses soins pour un embarras gastrique; sous l'influence du traitement les nausées et les douleurs épigastriques disparurent, mais à ce moment survint une diarrhée qui dura encore quinze jours plus tard. M. Marques note la rareté des vomissements et fait remarquer qu'il y a de la diarrhée dans presque tous les cas. Avant et après la découverte de la cause du mal, M. Dubrandy soigne soixante-trois personnes intoxiquées qui ont présenté des éruptions cutanées ou des phénomènes nerveux. Chez huit, il n'y a eu ni vomissements ni diarrhée, mais seulement de l'inappétence et des nausées. Le même observateur a noté encore le pyalisme avec sensation pénible de constriction rétro-sternale et épigastrique. M. Vidal parle de la présence de plaques rouges sur la muqueuse du voile du palais et celle du pharynx.

Il est difficile de donner des notions précises relativement à l'époque de l'apparition et à la forme la plus fréquente des manifestations cutanées. Tantôt, c'était un symptôme initial (du moins c'était à cause de lui que les malades s'adressaient au médecin) qui existait en même temps que les troubles digestifs; d'autres fois, les exanthèmes ne se montraient qu'après l'apparition des parasthésies des membres; enfin, dans certains cas, lorsque la plupart des autres phénomènes étaient rétrogradés, les éruptions tardives furent les plus opiniâtres.

S'il on voulait donner un nom adapté exactement à la forme de toutes ces éruptions, il faudrait épuiser la nomenclature dermatologique actuelle. Les taches se superposent et se remplacent sans qu'il soit possible de fixer de règle à propos de leur évolution. Le malade de M. Vidal a d'abord des plaques d'urticaire qui sont le siège d'un prurit pénible.

Le lendemain, l'aspect change; on voit poindre entre elle des taches d'une nouvelle forme, qui, au bout de quelques heures, rappellent à s'y méprendre celles de l'éruption rubéolique; elles subissent une desquamation assez rapide, et se résolvent en une sorte de poussière épidermique très fine. Tout n'est pas fini. Un autre exanthème à macules saillantes, de couleur café brûlé, se montre en différents points du corps, après avoir débuté aux jambes. La desquamation totale de la plante des pieds et de la paume des mains devient imminente;

un sillon d'aspect cuivré indique la limite précise jusqu'à laquelle elle se fera. Dans un cas de M. Dubrandy, l'ongle d'un orteil tomba et ne tarda pas à se reproduire. Au milieu de ces éruptions confuses, deux méritent une mention particulière. Un malade de M. Marques, un homme de soixante-sept ans, dont nous aurons l'occasion de dire un mot, eut une ulcération du gland qui ressemblait à s'y méprendre à un chancre. M. Dubrandy mentionne des plaques du couleur cuivré et à contour circiné, ressemblant au psoriasis syphilitique. Plusieurs de ces éruptions durèrent longtemps, certaines n'étaient même pas guéries à l'époque où les travaux ont été adressés à l'Académie. MM. Marques et Dubrandy ont noté dans un cas, sur le rebord gingival, la présence d'un liséré semblable à celui de l'intoxication saturnine.

Les accidents nerveux ont été les plus importants; c'est, comme nous l'avons vu, en tenant compte de leur modalité que M. Vidal est arrivé à songer à l'acrodynie.

En général, ils débutaient par une diminution de la puissance des muscles servant à la station et à marche (muscles pelvi-trochantériens et des membres inférieurs); les malades étaient fatigués, ils avaient un peu de difficulté dans les mouvements, puis la sensation s'accroissait, leurs jambes devenaient pesantes; ils ne marchaient plus que le tronc incliné en avant, en titubant comme s'ils avaient eu de la peine à détacher leurs pieds du sol et à reprendre l'équilibre à chaque pas qu'ils faisaient. Ils s'avançaient les jambes à moitié fléchies; la pointe des pieds traînait et battait. D'autres malades s'affaissaient inertes sur eux-mêmes, lorsqu'ils essayaient de se mettre debout, et pourtant tous les mouvements des jambes étaient possibles dans le décubitus dorsal. La contractilité électrique des muscles était intacte. Il y avait des contractions, des tressaillements, surtout dans les mollets.

Il existait des troubles de la sensibilité en même temps que des troubles de la motilité; les premiers persistaient souvent après les seconds et avaient une ténacité désespérante. La sensibilité à la pression était amoindrie; certains malades ne sentaient plus le sol et pourtant accusaient des fourmillements, des douleurs intermittentes, fulgurantes, surtout la nuit; il le caractérisaient par des comparaisons pittoresques telles que celle-ci: "des chiens me rongent la peau des mollets et de la plante des pieds"; parfois les parasthésies étaient plus étendues, presque généralisées; il y avait de la céphalalgie, des points pleurodyniques; un enfant de neuf ans se plaignait qu'il avait des papillons dans les dos. Les diminutions et les modifications de la sensibilité s'accompagnaient d'une hyperesthésie cutanée très pénible. Nous avons vu que le contact des draps ne pouvait être supporté par l'un d'eux.

Les altérations de la sensibilité spéciale furent moins constantes. Pourtant le toucher fut souvent émoussé; un malade ne pouvant sentir sa plume écrire, a-t-on dit, avec le bras; par suite d'une circonstance analogue, un enfant dut cesser momentanément de fréquenter l'école. L'audition fut peu altérée. M. Dubrandy a signalé des désordres oculaires de différente nature qu'il met sur le compte de l'empoisonnement; ainsi, chez trois conturières, la diminution de l'acuité visuelle fut telle qu'elles cessèrent de pouvoir travailler; à l'ophthalmoscope il constata une hyperémie rétinienne assez marquée; l'amblyopie finit cependant par disparaître. Le même auteur croit également qu'une double cataracte à développement rapide avait eu une origine identique; ce qui rend cette opinion vraisemblable, c'est qu'on trouva du cristallin observé dans les mêmes conditions n'alla pas jusqu'à l'opacité et cessa en même temps que les autres symptômes (Dubrandy).

Chez plusieurs individus, on a noté une impuissance sexuelle qui a duré plusieurs mois.

Pour avoir le tableau complet, il faudrait ajouter aux phénomènes que nous venons d'énumérer et qui démenèrent la scène, d'autres manifestations moins fréquentes peut-être, mais parfois aussi importantes que les premières et capables de créer une physionomie propre à un cas donné. C'est d'abord un catarrhe bronchique contemporain des exanthèmes, assez intense pour avoir produit quelquefois une dyspnée inquiétante; c'était, selon toute probabilité, une détermination morbide comparable à celle qui avait lieu sur la peau. Ce catarrhe s'accompagna de coryza, d'injection conjonctivale et, dans un cas, d'exophtalmie; il a souvent plus éprouvé le malade que les troubles digestifs; son existence permet de supposer, comme l'a cru M. Marques, que bon nombre des gripes développées vers la fin de l'hiver n'étaient en réalité que des déterminations anormales. Viennent ensuite les œdèmes partiels

(bouffissure des paupières et de la face, enflure autour des genoux et des malléoles), l'amaigrissement, la glycosurie transitoire notée par M. Vidal.

Il résulte de ce que nous venons de voir que les ingestions répétées de doses dissimulées, mais relativement élevées, d'arsenic n'ont été suivies que d'accidents peu importants correspondant à la période d'absorption; les plus sérieux se sont montrés pendant la diffusion dans l'organisme et surtout l'élimination. Jamais probablement ils n'ont occasionné la mort. Onze personnes ayant bu du vin venant de la cave dangereuse avaient succombé pendant la période des empoisonnements. Par ordre de l'autorité, les cadavres furent exhumés et soumis à l'autopsie médico-légale. Trois fois seulement on trouva de l'arsenic et deux fois une dose capable d'occasionner la mort: les cadavres appartenaient à un phthisique arrivé au dernier degré de la maladie, et à un diabétique qui depuis assez longtemps avait une quantité considérable de sucre dans les urines. Ni les experts, ni les médecins traitants n'attribuèrent la terminaison funeste à l'acide arsénieux.

Fait curieux, cette substance paraît avoir exercé une ou deux fois, malgré les bizarreries du mode d'administration, un effet thérapeutique: un homme de cinquante-cinq ans, soigné par M. Marquet pour un asthme à accès fréquents, n'en eut plus depuis l'apparition des parésies d'intoxication; un vieillard de soixante-sept ans, dont nous avons déjà parlé, a été débarrassé d'accidents goutteux lui rendant depuis plusieurs années la marche impossible. Si satisfaisants que soient ces résultats, nous ne songeons pas à recommander aux partisans la méthode de traitement qui les a donnés.

Reste une question. M. Vidal a parlé d'acrodynie et cela avec beaucoup de sens clinique. Peut-on accepter son idée et se servir de l'épidémie d'Hyères, pour en expliquer d'autres restées comme autant de problèmes non résolus dans l'histoire de la pathologie? Ce serait une éventualité désirable. Les épidémies en question ne se perdent pas dans les brumes du moyen âge; on n'est pas obligé pour les connaître de faire un long travail d'archéologie et d'exégèse sur des chroniques naïves et mensongères; elles ont été étudiées par nos maîtres, par les médecins, les plus instruits du temps; elles sont presque contemporaines, et, malgré cela, nous sommes obligés de faire l'aveu désobligeant que nous ne savons ni quelle était leur nature, ni ce qui les produisait. Peut-on, après les épisodes du Midi, déclarer ces épidémies étaient une forme d'arsénisme due, selon toute probabilité, à l'addition d'acide arsénieux à des matières alimentaires?

Je ne le crois pas. Sauf dans l'épidémie observée pendant la campagne de Crimée, le processus clinique

fut notablement différent. A Hyères, les phénomènes gastro-intestinaux n'ont existé que pour mémoire; s'il n'y avait eu qu'eux, les malades les auraient supportés sans se plaindre et probablement les médecins n'auraient jamais songé à faire d'enquête.

Dans les acrodynies de Paris, de Meaux, de la Ferté-Gaucher, de Coulommiers, il y a eu des diarrhées rebelles, opiniâtres, absorbant encore l'attention à l'époque des parésies: des diarrhées cholériformes et dysentériques. La seule différence dans la manière dont ce symptôme se comporta ne permet guère d'assimiler les acrodynies d'il y a soixante ans à l'arsénisme. Puis, il y a, dans celles-là, des bizarreries de diffusion. La maladie d'Hyères est restée cantonnée dans la zone où l'on débitait la denrée toxique; l'acrodynie sautait d'un quartier à l'autre, d'un département à l'autre, et aucune relation commerciale ne pouvait expliquer ces particularités. De plus, il y eut enquêtes sur enquêtes. On connaissait l'empoisonnement par l'arsenic à peu près aussi bien qu'on le connaît aujourd'hui. Tout fut scruté, examiné; les soldats qui ne buvaient pas de vin étaient malades, et les civils qui en buvaient dans le voisinage ne l'étaient pas; le pain des quartiers de Lourcine ou du Faubourg-du-Temple ne valait ni plus ni moins que celui des quartiers voisins. Jamais, nulle part un fait typique comme celui qui mit le Dr. Roux sur la voie (arsénisme chez le mari qui boit du vin, immunité du reste de la famille qui n'en boit pas) n'a été constaté. Malgré des similitudes indiscutables, nous ne trouvons pas dans l'évolution et la nature de la maladie d'Hyères une explication qu'on puisse adapter intégralement aux épidémies d'acrodynie, et nous en restons aux conjectures de nos devanciers. C'étaient probablement des maladies d'alimentation, mais on ne sait à quel produit rattacher les accidents qui les caractérisèrent.

Quoi qu'il en soit, les études que nous avons eu l'occasion de parcourir et que nous venons d'analyser sont intéressantes par l'importance des observations et la justesse des aperçus qu'elles renferment. Votre rapporteur a donc l'honneur de vous proposer d'adresser aux auteurs, MM. les D^{rs} Vidal, Marquet et Dubrandy, les remerciements de l'Académie.

Bien, que M. Roux n'ait envoyé aucune communication à l'Académie, votre rapporteur croirait être injuste en ne rappelant pas aussi la grande part que cet observateur a eue dans la découverte de la véritable cause de l'épidémie qui a frappé la population d'Hyères.

Les conclusions du présent rapport, mises aux voix, sont approuvées par l'Académie.

NOTE on Administrative questions arising out of the recent Epidemic, by Dr. CAMPBELL BROWN (Q. 6938).

If recent events are followed by legislation, it seems undesirable to legislate for beer alone, which will be well looked after now that it is known to be liable to contain arsenic, and to leave out of account all the other things, known or unknown, which are liable, or will in the future be liable, to be in some way contaminated with other things. Any new legislation should aim at securing immunity from contamination for all kinds of food and drink.

As regards Arsenic in Beer.—Considering the fact that the use of arsenical glucose was the result of combined ignorance and carelessness, that it was immediately stopped when discovered, and that it is not likely to ever occur again, and considering also that arsenic is exceedingly likely to get into beer from malt, and that, in fact, minute traces are very seldom absent, it would be vain to prohibit the use of glucose and invert for the purpose of preventing arsenication of beer. The question of permitting or prohibiting the use of sugars must be settled on entirely different grounds.

I suppose the Inland Revenue officers can deal at present with both glucose and malt; the local inspectors under Sale of Food and Drugs Act can do so, but they can only take samples as they are delivered to the brewer, and with his consent. They cannot go to the malster or his coke merchant, nor to the sulphuric acid maker; nor could they take samples of coke or of sulphuric acid even as they are delivered to the malster or glucose maker. They ought to have this power.

Necessity for Standards of Arsenic.—Before going further on the subject of legislation I ought to mention another point as regards arsenic.

Arsenic is everywhere in more or less minute traces. The air of towns, yeast, malt, beer, bread, everything containing or made with soda, and so on, contain minute traces. These traces are usually negligible, and are neglected. They are called nothing quite properly, and articles containing them are called pure.

That is right, but the traces exist, and the question must arise, At what point does the negligible quantity and the important quantity meet?

It is useless to say no arsenic should be present. It must and will be present, and can be detected if sufficiently large quantity of sample is examined. It would be impracticable to prohibit any trace of arsenic alike in malt and in sulphuric acid and in other things.

The question of standards cannot be got rid of. Unless the Legislature provides some simple and efficient means of fixing the standard of arsenic and other things there will be a great deal of useless litigation and great want of uniformity. One analyst will give a common-sense opinion, that such-and-such a quantity is of no consequence, or is not more than is usual or inevitable. Another will say of a quantity so small as to be quite indeterminate with any approach to precision, although it can be detected with certainty, that it is "deadly poison," although he has probably a larger quantity in his own body at the time, he being in perfect health. The courts will give varying decisions, and no one will know what to do. No state of things could be worse for trade and the public.

Similarly with sulphuric acid. No maker will guarantee that his acid is absolutely free from any trace of arsenic. It is most difficult to get even a small quantity of sulphuric acid absolutely free. But any manufacturer will guarantee that his acid is purified down to any absolutely safe limit which can be reasonably fixed.

After giving much thought to the consideration of possible legislation, I venture to express the opinion that legislative machinery is needed in the following directions:—

A.—Duties of Manufacturers.

1. To make it compulsory for manufacturers to test every bulk or batch sent out of any article which is to be used in the preparation, manipulation, conveyance, or storage of any food, for any impurity which would "impair the wholesomeness of such food." (See Fertilisers and Feeding Stuffs Act.)

Manufacturers to be presumed to know the use to which the thing he sells is put, unless he shows that he could not reasonably be expected to find out.

2. To enact that if the article is sold for use in the preparation, treatment, conveyance, or storage of any food, then shall be implied a warranty that such article is free from all ingredients which would impair or injuriously affect the wholesomeness of such food.

3. Manufacturers buying any such article for the preparation or treatment, etc., of food, should be required—

- (a) To inform the vendor of the purpose for which he wants the article.
- (b) To check the purity of each bulk or batch delivered.

B.—Powers under Sale of Food and Drugs Acts.

4. The Sale of Food and Drugs Acts should be extended so as to give power (a) to Inland Revenue or other Local Government Board officers, and (b) to inspectors for local authorities, to take samples of and to trace back to the manufacturer or to its original source (even out of the inspector's own district) any article used in the preparation or manipulation, etc., of any food or drug (using the definition of food in the Act of 1899), taking samples at each or any stage, and to have the samples analysed to ascertain whether (1) and (3) have been efficiently complied with, and to prosecute if occasion arises.

C.—Regulations by Government Department.

5. To authorise the Local Government Board when desirable or necessary, or when called upon to do so, to make regulations after inspection and inquiries, fixing a standard quantity of any specified ingredient in any specified article of food or article used in the preparation of food, above which the article shall be presumed to be impure, and below which the said article shall be presumed to be genuine.

For example, a regulation might prohibit the use of more than 4 per cent. of lead in the metal for siphon lemonade, etc.

To specify a standard quantity under this fifth provision would be far more satisfactory and workable than the provision so often recently suggested that the legislature should prescribe a standard mode of testing. The idea underlying the latter suggestion is that a test should be so designed and carried out as to fail to detect a small quantity (of arsenic, for example) which might be considered passable, and which would at the same time easily detect penal quantities. Any such test would be most variable in practice, and lead to confusion. No two men would get the same result from the same sample. In respect of arsenic, the suggestion means that either Marsh's test—a most inexact and unreliable test in practice—or Reinsch's test—a good qualitative test—should be so conducted as to have an approximate quantitative value; and that this approximate value should have a legal compulsory recognition. To legalise a variable quantity would be foolish and disastrous. Either of these tests gives results which not only vary with the mode of working (which by hypothesis would be fixed by enactments), but vary also with the operator, with the circumstances and condition of the article, and the other things with which it is mixed.

The only rational standard for legislation to fix is an absolute standard of so much actual arsenic which can be determined by weighing or other exact means. This real quantity being fixed, then if any individuals or firms choose to take the short approximate way of ascertaining the quantity which they may find sufficiently reliable in the hands of their own chemists, they would be at liberty to trust to that mode of testing at their own risk; but the ultimate appeal would always be to the balance or some equally precise determination, and not to any method which is at best only a method of more or less happy guessings.

In fixing standards regard should be paid to what is practicable in working the Acts, and practicable for the manufacturer, and practicable for the inspector and analyst.

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BAKING POWDERS: Liability to contain arsenic (Kirkby), 3704-6.

CLARET: Use of glucose in (Wahl), 7442-5.

COLOURED CONFECTIONERY: No arsenic recently found in (Stevenson), 2478. No arsenic found in (Jones), 1788-1791.

DRIED APPLES: (Stevenson), 2341-2351.

GOLDEN SYRUP: No arsenic found in (Jones), 1777-1780.

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See also PROSECUTIONS, PUBLIC ANALYSTS, OFFICIAL CONTROL.

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Arsenic in (Jones), 1823-1833; (Delépine), 5247; (Earp), 7100. Arsenic in malt mainly attributable to (O'Sullivan), 5754. No arsenic found in some coke-dried malts (Tomson), 3128-3137.

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YORKSHIRE COAL:

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POWERS OF, AND ADMINISTRATION BY, IN RELATION TO ARSENIC IN BEER:

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MALT:**ARSENIC IN MALT:**

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BRUSHING AND SCREENING OF MALT:

Brushing reduces amount of arsenic (O'Sullivan), 5743, 5793-4; (Brown), 6710, 6770; (Earp), 7105-6. Should remove all arsenic (Stopes), 8159, 8173-5. Desirable apart from arsenic (O'Sullivan), 5846-7. Brushing by Newcastle Brewery Co. (Lovibond), 7057-9. Required by Manchester Brewery Co. before epidemic (Deakin), 3887-3890. Malt bought brushed and screened (Blundell), 5031-2. Brushing being adopted at Burton (O'Sullivan), 5779; at Threlfall's Brewery (Tomson), 3169. Screening already done (Tomson), 3166.

Description of process (Taylor), 5462-5515 (Lovibond), 6970-3.

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MALT—continued.**MALT CULMS OR COMINGS :**

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Formation of (Niven), 670-5; (Taylor), 5548, 5594.

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I.—TABLE OF EQUIVALENTS OF PARTS PER MILLION AND GRAINS PER GALLON AND GRAINS PER POUND, RESPECTIVELY.

Parts per Million.	Equivalent to Grains per Gallon.	Equivalent to Grains per lb.
0.48	0033 = $\frac{1}{300}$	0003 = $\frac{1}{3000}$
0.5	0035	00035
0.57	004 = $\frac{1}{250}$	0004
0.64	0045	00045
0.71	005 = $\frac{1}{200}$	0005
0.83	0058	00058
0.95	0066 = $\frac{1}{150}$	00066
1	007	0007
1.43	01 = $\frac{1}{100}$	001 = $\frac{1}{1000}$
1.77	0124	00124
1.9	013 = $\frac{1}{75}$	0013
2.2	015	0015
2.86	02 = $\frac{1}{50}$	002
3.9	027	0027
4.76	033 = $\frac{1}{30}$	0033 = $\frac{1}{300}$
5	035	0035
5.71	04 = $\frac{1}{25}$	004 = $\frac{1}{250}$
7.14	05 = $\frac{1}{20}$	005 = $\frac{1}{200}$
8.93	062 = $\frac{1}{16}$	0062 = $\frac{1}{160}$
10	07	007
11.9	083 = $\frac{1}{12}$	0083 = $\frac{1}{120}$
14.3	1 = $\frac{1}{100}$	01 = $\frac{1}{1000}$
17.9	125 = $\frac{1}{8}$	0125 = $\frac{1}{80}$
23.8	166 = $\frac{1}{6}$	0166 = $\frac{1}{60}$
28.6	2 = $\frac{1}{50}$	02 = $\frac{1}{500}$
35.7	25 = $\frac{1}{4}$	025 = $\frac{1}{40}$
47.6	33 = $\frac{1}{3}$	033 = $\frac{1}{30}$
71.4	5 = $\frac{1}{20}$	05 = $\frac{1}{200}$
95.2	66 = $\frac{1}{15}$	066 = $\frac{1}{150}$
107	75 = $\frac{1}{13}$	075
142.9	10	1 = $\frac{1}{100}$
214.3	15	15
250	175	175
285.7	20	2 = $\frac{1}{50}$
357.1	25	25 = $\frac{1}{4}$
428.6	30	3

I.—TABLE OF EQUIVALENTS, &c.—*continued*.

Parts per Million.	Equivalent to Grains per Gallon.	Equivalent to Grains per lb.
71·43	5·0	·5
142·87	10·0	1·0
214·29	15·0	1·5
285·71	20·0	2·0
357·14	25·0	2·5
428·57	30·0	3·0
571·43	40·0	4·0
714·29	50·0	5·0
857·14	60·0	6·0
1000·0	70·0	7·0

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II.—MISCELLANEOUS.

1 gallon = 8 pints = 4.54 litres = 4,540 c.c.

1 gallon water weighs 10 lbs. = 70,000 grs. = 4,540 grammes.

1 pint = .567 litre = 567 c.c.

1 litre = .22 gallon = 1.76 (say 1 $\frac{1}{4}$) pints.

1 litre water weighs 1,000 grammes = 2.2 lbs. = 35 $\frac{1}{2}$ ozs.

100 c.c. = .022 gallon = .176 pint (say $\frac{1}{6}$ pint).

A barrel of beer = 36 gallons = 163.44 litres.

A quarter of malt = 8 bushels = 8 \times 42 lbs. = 336 lbs.

Percentage of Glucose (or other brewing sugar) means the weight of glucose per cent. of the total materials (malt plus glucose, &c.) used.

Equivalent of Glucose (or other brewing sugar) to *Malt*.—For Excise purposes 28 lbs. of cane sugar, or 32 lbs. solid glucose or saccharum, are deemed equivalent to 1 bushel (42 lbs.) of malt.

Priming.—Excise allows priming up to 1 $\frac{1}{2}$ per cent. by volume (or half-gallon per barrel) of a syrup of specific gravity not exceeding 1.150.

To ascertain weight of sugar corresponding to a given quantity of priming solution, divide the excess degrees of specific gravity above 1.000 by 38.6; result is lbs. of sugar per gallon of priming solution.

Thus the maximum weight of sugar allowed as priming per barrel (half-gallon) would be $\frac{1}{2} \times \frac{1.50}{38.6} = 1.94$ lbs.

This maximum, 1.94 lbs. per barrel, is equivalent to the addition of .054 lb. priming sugar per gallon of beer.





