The adulteration of food : conferences by the Institute of Chemistry on Monday and Tuesday, July 14th and 15th : food adulteration and analysis.

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Institute of Chemistry.

FOOD ADULTERATION AND ANALYSIS.

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THE

ADULTERATION OF FOOD.

CONFERENCES BY THE INSTITUTE OF CHEMISTRY ON MONDAY and TUESDAY, JULY 14th and 15th.

FOOD ADULTERATION AND ANALYSIS.

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LONDON, 1884.

INSTITUTE OF CHEMISTRY.

Conference on Monday, July 14, 1884.

Professor W. Odling, M.A., F.R.S., President of the Institute, in the Chair.

The Chairman said the Executive Council of the Exhibition had invited the Institute of Chemistry to hold a conference on the very important subject of the adulteration of food, and the modes of analysing it, and he hoped that having before them a subject of this kind, to which so much attention had been paid by so many eminently qualified, a discussion of considerable interest must arise, and that some good in the way of increase of knowledge and increase of agreement as to the points desirable to attain in future must be arrived at.

FOOD ADULTERATION AND ANALYSIS.

By Dr. James Bell, F.R.S.

Adulteration, in its widest sense, may be described as the act of debasing articles for pecuniary profit by intentionally adding thereto an inferior substance, or by taking therefrom some valuable constituent; and it may also be said to include the falsification of inferior articles by im-

parting to them the known appearance of commodities of superior quality.

The evils of adulteration may be viewed either from a sanitary, moral, or pecuniary standpoint, and it is no doubt chiefly in its relation to the health of the people that the subject of Food Adulteration and Analysis has been chosen for a Conference in connection with this Exhibition.

Of the sanitary evils of the adulteration of food there cannot be the faintest doubt, and even on this ground alone the practice merits the severest condemnation. This is the case when the substance added merely reduces the nutritive value or characteristic property of the food, but the offence becomes highly criminal when the adulterant also possesses properties injurious to health.

The moral aspect of this question should never be lost sight of. No man can continuously practise deception without losing self-respect, and, also, when detected and exposed, the respect of his fellow-citizens. Moreover, in such circumstances, a feeling of uncertainty on the part of the buyer is created, and his first idea on the receipt of a commodity of somewhat lower quality than usual is that it must be adulterated. The honest vendor thus shares with the dishonest one the general penalty of suspicion, and the transactions of nearly all dealers in articles of food are viewed with distrust.

But it is from the pecuniary standpoint that the question is most often viewed by the general public, for the primary cause of adulteration is a desire for unjust gain to be obtained, either at the expense of consumers, or by taking unfair advantage of competitors in trade.

If the adulterated article is sold at the ordinary price of the genuine commodity, the consumer is robbed of the amount represented by the diminished value; whereas, if it be sold as genuine, though at a proportionate reduction in price, the unfair competition tends either to seriously injure their honestly-disposed rivals in trade, or, what is but too often the case, to drive them into a similar course. Attempts have sometimes been made to estimate roughly the

amount of pecuniary loss suffered by consumers owing to the adulteration of different articles of food, but, for my part, I have never been able to see that any reliable data were obtainable upon which to form even the rudest approximate estimate.

The practice of adulteration is by no means of modern date, but has existed, more or less, from time immemorial. There is evidence that it was practised by the Greeks and Romans, and it has probably been co-existent with the development of commerce.

The earliest enactments in this country in reference to food appear to have had a much wider scope than those of recent years, for they embraced the quality as well as the genuineness of the article, and dealers in foods or drinks which, from whatever cause, were considered as unwholesome, were fined once or oftener, and then, if found incorrigible, were condemned to bodily punishment. The first enactment on the Statute Book is the 56 Henry III., cap. 6, passed in 1266. Under this and subsequent statutes or "Assizes," the baker was to be punished if he sold bread light in weight, or made from unsound wheat, or at too high a price in relation to that of wheat; the brewer if he was not sufficiently liberal with his malt in proportion to the price of barley; the beer-retailer if he sold ale drugged or short in measure; the vintner, if his wine was drugged, corrupted or unwholesome; and the butcher, if he sold diseased meat.

When we consider the difficulty which at the present time we experience even with increased knowledge and appliances in suppressing adulteration, it is not to be wondered at that the machinery of those days failed to put an end to the evils complained of.

With the exception of one or two Acts relating to the adulteration of bread, all the legislation upon articles of food from the time of George I. to the year 1860, had reference to the protection of the revenue, and therefore only indirectly guarded the health or pocket of the consumer. The Acts within this period related principally to

tea, coffee, beer and porter; and, if we are to place any reliance upon the words of an Act of Parliament, the adulteration of tea a hundred years ago must have attained very alarming proportions. The Act, 17 Geo. III., cap. 11, states that great quantities of sloe leaves, and leaves of ash, elder, and other trees and shrubs were then being manufactured and sold in imitation of tea, to the injury and destruction of great quantities of timber, woods, and underwoods.

In the year 1851 there was considerable agitation amongst planters and others interested in the production and sale of coffee, in consequence of the falling off in the consumption of that article caused by its wholesale admixture, as permitted by Treasury Minute, with chicory. Petitions were presented to both Houses of Parliament on the subject, and it was perhaps the general attention directed at that time to this matter which induced the proprietors of the *Lancet* to perform a public service of the highest value. In 1851 and several following years, at their own expense, they instituted an extensive inquiry into the character of the food, drink, and drugs sold in London, and engaged chemical and microscopical analysts for that purpose. The results showed that adulteration prevailed to an alarming extent, and that in many cases the adulterants were of a nature highly injurious to health. The Editor of the *Lancet* showed his confidence in the analysts employed by publishing in that journal the results of the analyses, whether favourable or otherwise, together with the name and address of the vendor. The increased public attention thus caused, resulted in an inquiry by a Select Committee of the House of Commons, in 1855, which reported that adulteration of food, drink, and drugs was very prevalent, and that some of the adulterants used were of a poisonous nature. Following upon that report, and as a consequence thereof, the first general Act in this country was passed in the year 1860. This Act may have exercised to some extent a deterrent effect, but beyond this the practical outcome of it was but small, for the appointment of analysts was permis-

sive, and the obtaining of samples for analysis was left to private purchasers. Another Act was passed in 1872, extending the right of appointing analysts to boroughs having separate police establishments, but still left such appointments optional. A most important provision, however, was made for the purchase of samples by local officials, and the right was given to private purchasers to have samples analysed on payment of a small fee.

The adoption of the Acts of 1860 and 1872 was by no means general, but was principally confined to London and the large towns; and even where adopted, the action taken was often of a very restricted character. The prosecutions which ensued, however, were sufficiently numerous to cause a general outcry from tradesmen about alleged miscarriages of justice; and in answer to petitions from most of the large towns, the Government decided to appoint another Select Committee of the House of Commons to enquire into the working of these Acts. This Committee reported that while the Acts had done much good, they had likewise done considerable injury, as many heavy and undeserved penalties had been inflicted upon respectable tradesmen, and that such injury had arisen partly from the want of a clear understanding as to what constitutes adulteration, and partly from the conflicting opinions and inexperience of the analysts employed, some of whom appeared to have evinced a great want of discretion. It was recommended that the Acts of 1860 and 1872 should be repealed, and that a new, extended, and compulsory Act should be substituted for them. The chief amendments suggested were the inclusion of the fraudulent abstraction of an important property of any commodity, such as the removal of cream from milk, as a punishable offence; the examination of tea on importation; better regulations for obtaining samples, and for securing the appointment of qualified food analysts. To meet an important want provision was also made for obtaining an independent analysis in case of dispute.

A great improvement had evidently taken place since

the previous Parliamentary Committee had sat in 1855, especially in regard to the deleterious nature of adulterants used, for this Committee concluded their Report by expressing their belief that it will afford some consolation to the public that in the matter of adulteration, they are *cheated* rather than *poisoned;* and that if deleterious substances are occasionally used for the purposes of adulteration, they are used in such minute quantities as to be comparatively harmless. Further, as a matter of policy, they pointed out that they did not consider that Parliament desired needlessly to hamper or fetter trade, still less to interfere between the buyer and seller with the view of regulating prices, or attempting to assist the consumer in ascertaining the real money value of any marketable commodity.

Upon the lines indicated in this Report was framed the Bill which passed into law as the Sale of Food and Drugs Act, 1875, and which is the Act now in force, though amended in some respects by the Sale of Food and Drugs Amendment Act, 1879. I shall now pass on to consider 1st, the object of these Acts; 2nd, the machinery provided for attaining that object; 3rd, how far the Acts have succeeded; and 4th, analysis in relation to adulteration.

The title of the Act of 1875 states that it is "to make better provision for the Sale of Food and Drugs in a pure state." Although expressly intended to suppress adulteration in food, drink, and drugs, the word "adulterant" or "adulteration" does not occur in any of the clauses, for the reason, I believe, that no definition of these terms could be framed to meet all practical requirements. The sale of mixtures is freely allowed, provided that the nature of the commodity sold is brought to the notice of the purchaser before the sale is completed, so that if necessary it may be declined, and that no ingredient has been added so as to render the article injurious to health.

The fundamental idea of the Act is found in Section 6, which enacts that "no person shall sell to the prejudice of the purchaser any article of food, or any drug, which is not of the nature, substance, and quality, of the article demanded

by such purchaser." Here is a clause capable of a very wide definition, but I think the spirit of the section is fairly expressed by Mr. Justice Mellor in delivering judgment in the Appeal Case of Hoyle *v.* Hitchman, when he says, "The offence intended to be prevented by the Act was the fraudulent sale of articles adulterated by the admixture of foreign substances which would necessarily be to the prejudice of the purchaser, and those words were inserted only to require that such adulteration should be shown to have been made;" and further, "if the purchaser asks for a certain article, and gets an article, which by reason of some admixture of a foreign article, is not of the nature or quality of the article he asks for, he is necessarily prejudiced."

It would thus appear that for a purchaser to be prejudiced within the meaning of this clause, it is necessary that the article sold should contain some admixture of a foreign substance not specified at the time of sale; and therefore that the purchaser is not legally prejudiced when the article sold is of low quality but genuine. This view will be found confirmed in the twelfth Report of the Local Government Board, in which it is stated that "the Sale of Food and Drugs Acts are not designed to prevent the sale of poor articles, but that of adulterated articles." It has been urged that samples should be judged by those of average quality, which the purchaser might reasonably expect to get; but this was evidently not the view of our legislators, for Parliament deliberately abstained from fixing limits of quality for natural products, whether in a raw or prepared state.

I come now to the means provided for suppressing the adulteration of food. The Local Authorities of each city, metropolitan district, county or borough, throughout the United Kingdom, have now the power to appoint inspectors and duly qualified analysts for the purchase and analysis of samples, and should they not appoint an analyst voluntarily, they are required by the Act to do so when called upon by the Local Government Board in England, or a

corresponding authority in Scotland and Ireland. When any sample purchased, according to the provisions of the Act, is found adulterated, the vendor can be summoned before a magistrate, and on conviction fined in a sum not exceeding £20 where the adulteration is simply to the prejudice of the purchaser. When, however, the adulterant renders the article injurious to health, the maximum penalty is £50 for a first offence, and six months' imprisonment on subsequent convictions.

On payment of a fee not exceeding 10*s.* 6*d.* a private purchaser may have any article analysed by the public analyst, and, if found adulterated, the vendor, if the provisions of the Act have been complied with, may be prosecuted and fined as if the purchase had been made by the inspector. The requisite official machinery has not been provided in all places, and the Local Government Board do not appear to have power to enforce the appointment of inspectors, nor the purchase of a sufficient number of samples to ensure the efficient working of the Act.

I find, on inquiry, that though analysts have been appointed for most places in England and Wales, there were no fewer than sixty-three boroughs and three counties in which no samples whatever were analysed during the year 1883, and in many other places the number analysed was very small.

In Scotland, out of thirty-two counties only seven have yet appointed analysts, and of these two have had no samples examined for six years, while a third has only had one sample, and a fourth only three samples analysed during the last three years. Of 167 royal and police boroughs, thirty have appointed analysts, thus showing only thirty-seven appointments for the whole of Scotland out of a possible total of 199, or about one in five.

In striking contrast to Scotland is Ireland, where an analyst has been appointed for every place except one borough and one county.

In considering some of the general results which have been obtained by the working of these Acts, it

would manifestly be unfair to institute a comparison between the years prior and subsequent to the Act of 1879, which laid down minimum strengths for spirits, so I confine my statistics to the last three years for which returns have been issued by the Local Government Board. I regret that I have been unable to obtain complete returns for Scotland and Ireland, so the following data for the years 1880, 1881 and 1882, showing the total number of samples analysed in each year, with the percentage of samples reported as adulterated, refer to England and Wales only.

Year.	Total Number of Samples Analysed.	Percentage Reported Adulterated.
1880	17,673	15·7
1881	17,823	14·6
1882	19,439	15·0

The percentage of samples found adulterated varies, as might be expected, somewhat from year to year in the various commodities; but on the whole, and so far as these returns show, it is practically stationary.

These are the only data available, so far as I know; and valuable as they are for comparison from year to year, there are several reasons why they afford only a roughly approximate idea of the extent to which adulteration is practised in this country. On the one hand, the samples are nearly all purchased by inspectors, many of whom are personally known to the tradesmen,—the object for which the purchases are made being perfectly well understood;—whilst some districts throughout the country are inadequately, if at all, represented. On the other hand, a large number of samples are returned as adulterated where the amount is so small that no proceedings are instituted; and to these may be added samples of which adequate notice

of admixture had been given at the time of purchase, and also samples of impure well-waters, which are sometimes classed as adulterated. I may also mention that of 528 samples purchased by private individuals in one year, the percentage found adulterated was 25, as compared with only 14·5 per cent. in the samples purchased by the official inspectors during the same year; but this may partly be accounted for by the fact that a private purchaser has generally good grounds for suspecting adulteration before going to the trouble and expense of having the article analysed. The small number of samples submitted for analysis by private purchasers has been more than once commented upon by the Local Government Board, and shows, I think, that the expense of the analysis, together with the trouble involved in the event of a prosecution, are more than private individuals are willing to bear. Perhaps this is not surprising when it is considered how small an amount individually they have at stake, and how readily they can, when dissatisfied, change their tradesmen.

The working classes, especially, who form the bulk of the population, and are the greatest sufferers from adulteration, can hardly be expected to take action on their own account if only by reason of the expense; but there is often the further impediment of the analyst being many miles away, and doubtless in such cases his name and address are not always generally known.

It is much to be regretted that an evident unwillingness has been found on the part of some local authorities to bring these Adulteration Acts into operation. The Acts are practically a dead letter in some districts even where nominally complied with, owing to the small number of samples purchased, or the conditions under which the purchases are made. In the twelfth Report of the Local Government Board it is stated, that in some cases "scarcely any attempt is made to conceal the official character of the buyers, or the purpose for which they are buying;" and the Board add, what must be perfectly obvious, "that unless the samples obtained by the inspector are of the

quality ordinarily sold to the public, the object of the purchase is frustrated."

In some districts the local authorities have been much discouraged by the small fines imposed by the magistrates, even when the offence has been committed more than once. There can be little inducement for them to carry out these Acts energetically when they find that after going to all the expense and trouble of the purchase and analysis of samples, and taking the necessary legal proceedings against a fraudulent tradesman, the heinousness of his offence is assessed by the magistrates at such a trifling sum as cannot in any view be held to be a deterrent penalty, but one readily covered by the illegitimate profits of a few days.

The tendency in recent years has been to place increased discretionary power in the hands of magistrates. For many years prior to 1879, their discretion in matters of fines in Revenue cases was limited to reducing penalties to not less than one-fourth of the amount named in the Act. By the Summary Jurisdiction Act of 1879, however, they were given full discretionary power in first offences, but the former restriction remains in force for second and subsequent offences. Some such regulation may be found desirable under the Sale of Food and Drugs Acts, especially in cases where the vendor is the actual adulterator.

In discussing the relation of analysis to adulteration, it is not my intention to review the various methods of analysis, but merely to refer briefly to some of the analytical difficulties experienced in dealing with the subject. When the adulterant differs chemically or microscopically from the article to which it is added, as when alum is added to flour or bread, or wheat flour to mustard, the detection of the adulterant is only dependent upon the skill and experience of the analyst. But when the adulterant is similar in character to, or identical with, one of the constituents of the article to which it is added, we are met at the outset with a formidable obstacle in the fact that natural products of all kinds vary greatly both in composition and quality, and the problem presented for solution

is then whether lowness of quality is due to natural poverty or to adulteration.

There are butters, for instance, so rich in quality that they would admit of a large addition of foreign fat, and still yield analytical results within the limits of genuine, but poor, butter. Again, it is well known that the milk yielded by some cows is of so low a quality as not to be equal to that from other cows with a large proportion of added water. Further, there are some teas which, regarded from whatever test of quality we may apply, are so rich that they will bear a considerable admixture of partially exhausted tea-leaves and still yield results equal to those from other poorer, but yet genuine, teas. This is the difficulty which, more than all others of a scientific nature, stands, and I fear will continue to stand, in the way of the entire suppression of adulteration.

Unfortunately, the history of food analysis shows that this difficulty in dealing with natural products has been increased to some extent by the adoption of different processes of analysis, which, in the hands of various chemists, have yielded results differing so materially as to lead to contrary opinions upon the same sample. To my mind, it is therefore most important that whatever analytical process is used, it should yield absolute, and not comparative, results.

There are, however, occasions on which differences of opinion between analysts may be expected to arise, as, for instance, when the microscope has to be depended upon for the detection and estimation of the adulterant. Any want of concord between analysts in respect to their estimate of the proportion of adulteration in such cases as the presence of barley-meal in oatmeal, or rice flour in ground ginger, should not be made too much of, as the certain proof of admixture is the main thing to be desired, and it can make but little difference whether the percentage of the adulterant be returned, say, as 15 or 20 per cent.

It is frequently urged that certain "limits," founded upon the analyses of samples of average quality, should be

laid down and legalised for natural products, below which such products should be deemed to be not "of the nature, substance, or quality of the article demanded," but the adoption of such "limits" might lead to grave difficulties. It is the opinion of practical men that it would be unwise to adopt any legislative measure with respect to limits of quality which would tend to discourage production, and diminish the supply of any article of food. It would manifestly be an economic blunder, if, for instance, in order to raise the quality of milk by one half of 1 per cent. on the non-fatty solids, the actual production were to be diminished by 10 per cent. in quantity.

Following these views, it may be of interest to particularise some of the principal articles of food, and the results of the analyses of samples under the Adulteration Acts of 1875 and 1879. I have taken the data from the Local Government Board's Reports, founded upon Returns made by the Public Analysts, and of which an able Summary for the five years, 1878 to 1882, will be found in a valuable 'Handbook on the Law of Adulteration,' by Thomas Herbert, published by Knight and Co., of Fleet Street.

Milk.—Beginning with milk, we find that it differs from most other natural food products in that it is sold to the public, and, as a rule, consumed, in its natural state; also in that it is difficult, from a general inspection of its appearance, or from its taste or smell, to form a fair idea of its quality; and further, in that within the same town or district it is mostly sold at a uniform price, except in special cases for nursery purposes.

The judging of the quality of milk may therefore be considered to be largely dependent on analysis, and having regard to the facility with which it can be adulterated, the public require a greater amount of assistance in order to secure a supply of genuine milk, than they do in the case of almost any other article of food. I have little doubt that in course of time, with the increasing means of education, the public will become more skilful in judging of the quality of milk and other commodities, and will be able

frequently to detect those instances of gross adulteration which may now pass unobserved.

The range of quality in the milks obtained from healthy and well-fed cows is very considerable. Taking the non-fatty solids of the milk as a criterion of value, I have found in common with others that the percentage varies—with a few exceptions on either extreme—from 8·2 to 10·8 per cent. It is evident that a milk of the higher value might be subjected to a good deal of watering—about 25 per cent.—and still yield the results obtained from the poorer, but still genuine, milk.

This opening to sophistication which the differences in the quality of milk permit, is not less, but even exceeded in the case of butter, owing to the greater range in its quality, a point I shall shortly have to notice.

For a long time it was contended that cows which gave milk containing less than 9 per cent. of non-fatty solids were either diseased or starved, but this notion may now be said to be dispelled, for the more the matter has been investigated the more has such a position been found untenable.

Milk yields very variable proportions of fat. The percentage is sometimes as low as 2·2, and occasionally rises to as high as 6. This great range of difference affords facilities in some instances for the abstraction of part of the cream, and unfortunately renders the analysis in such cases of but little value in protecting the public against this species of fraud—a circumstance much to be regretted when the high value attached to the fat of milk is considered.

As to the necessary groundwork of milk analysis, chemists are universally agreed. The data sought for are the percentages of fat, non-fatty solids, and ash; but, in order that the results of one analyst may compare with those of another, the processes employed for determining these data require to be uniform, and the methods themselves must be such as will yield accurate results.

As proceedings under the Adulteration Acts are of the

nature of a criminal prosecution, it is essential that the analysis should not indicate mere comparative results, but that the constituents relied upon for forming an opinion should be expressed by those weights or percentages which shall set forth the true quantity in the substance analysed, as absolutely as the most skilful analysis can provide.

About 6,300 samples of milk are analysed yearly in England, of which 20 per cent. are returned as adulterated. The offences are practically confined to addition of water and abstraction of cream, but occasionally preservatives, such as boracic acid, designed to prevent the milk from turning sour, have been found, and also, but still more rarely, sugar and colouring matters.

While admitting that in some districts the milk-sellers may be adequately sampled, yet, taking the country as a whole, the total number of samples analysed appears to me to be insufficient to show to what extent adulteration is generally practised, or to act as an effective bar to the practice.

Butter.—The supply of good, wholesome, and genuine butter for the public use is a desideratum. Fortunately, however, in this they are able in a great measure to become their own judges. They can readily distinguish between what is sweet and rancid, and can discover a butter which is heavily loaded with salt, and often detect the presence of an excessive amount of water. In fact, the public can practically protect themselves against most forms of butter adulteration, except that arising from the admixture of foreign fat.

Butter is another illustration of the difficulty with which chemists have to contend, arising from the wide variation in the composition of the article in a pure state; and, as in the case of milk, it is essential that, in order to avoid differences in results, and contrary opinions, the method of analysis adopted should be such as to effect a complete and accurate separation of what is termed the soluble and insoluble fatty acids. It is now generally admitted that the percentage of fixed fatty acids found in genuine butters

varies from 85·5 to nearly 90·0 per cent., so that the addition of something like 40 per cent. of a carefully selected foreign fat to the richest butter, would still leave the percentage of insoluble fatty acids within the range of a genuine butter.

As in the case of milk, chemists are agreed upon the lines to be followed for the determination of the genuineness of butter, and differences can only arise from variations in processes followed for the attainment of the necessary data.

About 1200 samples of butter are analysed yearly, of which 15 per cent. are reported against. The adulteration consists in the substitution or admixture of foreign fats, and occasionally in the introduction of an excessive amount of water.

In connection with this subject, I may mention that the manufacture of artificial butter compounds from animal and vegetable fats has, in recent years, attained enormous proportions in the United States of America. These compounds, known as butterine, oleomargarine, suine, &c., are in the opinion of high authorities legitimate articles of commerce, if sold under names which properly indicate their origin and composition.

If manufactured in a cleanly manner from sound fats, they are perfectly wholesome, and afford the poor a cheap and useful substitute for butter, especially during the winter months, when good butter is both scarce and dear. I see, however, that the Legislature of the State of New York has, at the instigation of the farming interest, resolved to suppress the manufacture and sale of such compounds within the bounds of that State.

This decision was based upon the evidence given in what is said to have been a very one-sided investigation, and in which it was stated that such compounds contained deadly germs; that the workmen engaged in their manufacture were subject to loathsome diseases; and that by their use the death-rate of New York had increased at an alarming pace. Putting aside such undoubtedly exaggerated statements, it is highly probable that with the increased demand

there may have been less care exercised in the manufacture than at first, and that in some cases impure or decomposed fats may have been used, but these are grounds rather for sanitary supervision than for the suppression of the trade.

Cheese.—It is considered that the consumer can in a great measure protect himself in his purchases of cheese. The range of prices plainly shows him the different qualities, and he can exercise his judgment in selecting the kind best adapted to his taste and pocket. I am not aware of any instance in which an adulteration of cheese has been reported. Colouring matter is about the only foreign ingredient employed in its manufacture, but this is a necessity to satisfy the public taste as regards colour.

The successful manufacture of factitious butter from animal and vegetable fats has naturally suggested their substitution for milk fat in cheese, but there is no evidence that "butterine cheese" has yet found its way into the English market. When it does, there are adequate chemical tests to distinguish it from the genuine article.

Bread.—About 1100 samples of bread are analysed annually, of which, on the average, 6 per cent. are shown as adulterated. The principal adulterant is alum, which was reported in one case as being present to the almost incredible amount of 1305 grains, or nearly 3 ounces to the quartern loaf. I do not think it would be questioned that so large an addition of alum must be injurious to the health of the consumer. The amount usually added, however, is comparatively small, being only about 30 to 40 grains in the 4-pound loaf, and whether then injurious to health or not is a matter in dispute, there being both chemists and medical men who take opposite views on this subject. When the objects for which alum is added are considered, that it is either to enable unsound flour to be used, or to cause the bread to appear to have been made from better flour than has really been the case, its use should be strongly deprecated, and its presence treated as an adulteration.

Tea.—The number of samples of tea analysed by public analysts is small, and the cases are very rare in which

adulteration is reported. This, no doubt, in part, arises from the scrutiny which tea undergoes on importation, which has had the effect of discouraging, in great measure, the trade in adulterated teas.

The manufacture in this country of spurious teas from the leaves of other plants, or from exhausted tea-leaves, is extinct; for the low price at which genuine tea can now be sold holds out but small inducement for the increased risk under the present adulteration Acts, of manufacturing and selling a spurious article. The methods of analysis adopted for the detection of the adulteration of tea are fairly effective, and the only form of sophistication which could be practised with any chance of success is the admixture by the Chinese of partially exhausted tea-leaves.

Coffee.—About 1250 samples of coffee are yearly analysed, of which 18 per cent. are reported as adulterated. With rare exceptions the sole adulterant found is chicory, which, it may be mentioned, is the only substance that can legally be added to coffee without requiring the payment of a further tax in the form of a stamp duty.

The adulterants of coffee all consist of vegetable matter, and allowing that the analyst is acquainted with the structure of the different vegetable tissues, their detection by the microscope becomes a matter of certainty.

In connection with coffee it may be noticed, and the remark applies equally to all substances on which a Revenue duty is imposed, that the interests of the public are largely though indirectly protected by the constant supervision and inspection which such commodities undergo, either in their manufacture or sale, so that before such articles in the adulterated state can come into the hands of the public analyst they must have evaded those safeguards which the restrictions of the Revenue Acts provide.

That such a result is brought about receives confirmation from the fact that it is seldom that a prosecution arises under the Food and Drugs Act, for the adulteration of a dutiable article with a marketable commodity not liable to duty.

Spirits.—Whisky, gin, rum and brandy are the only articles under these Acts which are required to be sold at not less than a specified strength, unless otherwise declared at the time of sale.

These spirituous liquors are in a different position to natural products, for being in all cases mixtures of manufactured spirit and water, the relative proportions of which are readily ascertainable, it was not unreasonable for Parliament to fix a minimum proportion for the essential constituent alcohol (defined in terms of proof spirit), below which the retail purchaser was to be considered "prejudiced," unless made aware of the fact at the time of sale. It is true that the percentage of alcohol is but one factor in determining the commercial value of spirits, and that a purchaser may receive better value for money in a well-matured spirit below the minimum strength, than if he were supplied with a less-matured article at or above that strength. The alcoholic value, however, is the only one which can be accurately estimated, and about which, therefore, analysts may fairly be expected to agree.

About 2000 samples of spirits are annually analysed, of which 25 per cent. are reported as adulterated, but only in very isolated cases has any other adulterant than water been found. This is a striking refutation of the opinion, so frequently expressed, that most of the evils of spirit drinking are due to adulteration, and no better illustration could be afforded of the frequency with which inferiority of quality is confounded with adulteration. On several occasions samples of whisky have been sent to me from districts where the people were said to have been injuriously affected by drinking the spirit, and I have never met with an adulterated sample, but the spirit was invariably of a raw and immature character. The changes that take place in the maturing of spirit whereby it loses its fiery character, and the deleterious traces of fusel oil, become changed into comparatively harmless flavouring ethers, are not well understood, and it is impossible by any mode of analysis at present known to separate spirits into the two clearly

defined classes, of those which are new and deleterious, and those which are sufficientiy matured as to be harmless, this being rendered all the more difficult by the common practice of blending spirits of various ages and flavours in order to get a mixture having a certain recognised character.

In some measure, to meet this difficulty, an effort was made a few years ago by a well-known Irish member of the House of Commons, an effort which is now being renewed, to move the legislature to enact that whisky before being sent out for consumption must have been kept in warehouse for at least one year. This attempt, however, did not succeed, through the trade difficulties which were found to beset such a plan.

The obstacles in the way of controlling the quality or genuineness of brandy are even greater than in the case of whisky, as its production is carried on outside this country, and the practice of adding a certain proportion of plain spirit and a mixture of sugar and flavouring matter to real brandy, has become fully recognised in the trade, and is allowed for in the purchase and sale of this article.

This addition of saccharine matter has a marked tendency to obscure the naturally harsh character of brandy, and to cause its coarse and immature nature to pass unnoticed by the public generally, while whisky being free from sugar at once appeals to the palate in cases where the spirit is of a new or fiery character.

That the circumstances indicated create formidable difficulties in the application of chemical tests to brandy suspected to contain added spirit is clearly evidenced from the fact that there does not appear to have been any successful prosecution under this head in connection with the Food and Drugs Act.

Beer.—This, from its position as the national beverage of this country, is of especial interest and importance in its relation to analysis and adulteration. Prior to 1847 beer could be accurately and legally defined as a fermented beverage prepared from malt and hops, but in that year sugar was allowed to be used. Fifteen years later, namely,

in 1862, the hop duty was abolished, and revenue interference with the use of hop substitutes ceased; then, in 1880, the malt duty was removed, and brewers were allowed by the Beer Act of that year to use any materials whatever capable of being used in brewing. There is no legal limitation as to the strength or original gravity of beer, nor as to the degree to which it shall be fermented, or, in other words, the proportion of alcohol it shall contain. It is, therefore, impossible to give a clear and concise definition of what beer ought legally to be. The former definition and still popular idea, that it is a fermented beverage prepared exclusively from malt and hops, is neither supported by revenue law nor by present trade practice, for there may now be legal beer without either one or the other, or even without both.

Under what circumstances then can a purchaser of beer be deemed to be prejudiced? The Local Government Board have stated that "it would seem to follow from decisions in the High Court of Justice that a purchaser in demanding beer must be held to mean the article ordinarily sold under that name, and that it would be to his prejudice to sell him, as beer, an article not of the nature, substance, and quality of that ordinarily sold as such, whether containing ingredients injurious to health or not." It is not easy to fix a basis or standard of quality for the article ordinarily sold as beer, for it is my experience, as well as that of other analysts, that even in the same town the money value of beer sold under the same name, and at the same price, differs by as much as 50 per cent. from whatever point of view its value may be considered. Suggestions have been made that, as in the case of spirits, minimum limits of strength, based upon original gravity, should be laid down by Parliament for the several well-recognised sorts of beer; but there would be many objections to such a course, more especially where the value of the beer depends more upon its character or flavour than upon its stength.

An Association has been formed to cause the ingredients

from which the beer has been made to be declared, but I fear that those who expect analysts to be able to prove or disprove the truth of such declarations rather overrate the present capabilities of chemical science.

A popular notion has long prevailed that no article is more manipulated than beer, and it is therefore satisfactory to find that there have been comparatively few prosecutions for the adulteration of beer, and, so far as I know, the only adulterant found has been common salt. Now the amount of common salt naturally present in beers varies widely, some of those containing the largest proportions being held by the public in high repute. As salt is added as an antiseptic, and really increases the keeping properties of some beers, it has been contended that the public cannot have been much prejudiced in those cases where a small quantity has been added, but where the total amount present is within the limits of a genuine beer held by them in high estimation.

It was my intention to discuss in detail several other subjects of interest, including wine, but it appeared to me that if I did so, the paper would prove too lengthy and tedious for the opening of a Conference.

I may say, however, that in most articles of food there has been a very great improvement in recent years as regards adulteration, and that the gross and deleterious forms of sophistication which are stated to have been extensively carried on at one time are now practically abandoned.

For example, the only substances which are now found in cocoa are sugar and starch, and in mustard, flour and turmeric, and these additions are not considered as adulterants so long as the preparations are not sold as pure or unmixed articles.

Again, in the manufacture of confectionery, not only has the use of earthy substances been discontinued, but the employment of pernicious colouring materials has practically disappeared, and harmless, vegetable colours are now almost universally employed.

Even in pickles and preserved vegetables it is now rare to find the colour heightened by the addition of a salt of copper, and the colour of cayenne pepper is no longer improved by the use of red lead.

In fact, in whatever direction we look, the same improvement is observable, judging from the Reports of the Public Analysts to the Local Government Board, and the absence of prosecutions.

Before concluding, I desire to express my opinion that the machinery provided by the legislature for the suppression of adulteration is fairly efficient, and only requires to be vigorously worked by the various local authorities in order to be productive of great good to the community. I trust that this Conference will be the means of stimulating these authorities to a more zealous administration of these Acts, and particularly of directing their attention to the advisability of obtaining samples for analysis from every part of their district, and with such precautions as will insure the purchase of articles in the state in which they are ordinarily supplied to the general public.

I cannot conclude, however, without expressing my sense of the efficiency of the work which has been, and is now being done by public analysts, not only in their official capacities, but in regard to their contributions to analytical science, of which their works on bread, milk, and butter may be cited as well known examples. It has been the least pleasant part of my duty to have to differ from them, as sometimes they have differed among themselves, at one time on actual results of analysis, and at another on the deductions to be drawn from practically similar results, but such instances should not affect the confidence with which the general ability and high services of public analysts ought to be regarded.

DISCUSSION.

The CHAIRMAN having thanked Dr. Bell for his very complete, interesting, and fair account, said he thought there would be pretty general agreement in several of the statements he had put forward. In particular he might take upon himself to declare how very largely the public was indebted to the labours of those many gentlemen who undertook very ably the office of public analysts, and how largely pure science was indebted to them for their labours. It was gratifying to hear from Dr. Bell that there had been so large an improvement in recent years in regard to adulteration, and that the gross and deleterious forms of sophistication which were stated to have been extensively carried on at one time were now practically abandoned. So far, therefore, the Adulteration Act may be regarded as a success. It must further be said that there could not be any doubt as to the sanitary evils resulting from the adulteration of food, and, therefore, in connection with the Exhibition they might congratulate themselves on the means of adding to the public health which had resulted from the working of the Act referred to. It would be admitted that, on the whole, the Acts had worked well; but a question arose whether they might not be made to work better, whether indeed in some particulars they did not imperatively call for amendment. If the question before the Conference was simply the repression of adulteration, it was quite obvious that the Acts might very considerably be amended in respect to their efficiency; but other conditions had to be borne in mind as well, and they could not conceal from themselves that to a small extent in some places, and to a larger extent in others, Acts of this kind were more or less prejudical to trade and invention. All were interested in the supply of pure and honest food, but they were all interested also in not

interfering with its abundant and cheap supply, or with the improvements in the mode of manufacture and productions of those articles of food which were more or less of an artificial character. He feared if the Act had been in force some forty years ago, what Dr. Bell had told them with regard to beer would have had no foundation, and that the supply and quality and cheapness of beer might have been very seriously interfered with by any very stringent and legislative enactment with regard to the materials from which it must be produced. But it was not for him to express his own view on any of these points, but rather to invite the opinion of others; but he must refer to one or two points with regard to the possibilities of an amendment of the Act, with the view of inviting those with most experience of the subject to say how far they thought it necessary that it should be altered in certain respects, and how far it was necessary to amend it so as to insure its general applicability, because at the present time there were considerable portions of the country where it was not actually applied at all. If the Act were really doing good, it seemed a pity that it should not be doing so over the largest possible area. It appeared that the Local Government Board had power to enforce the application of the Act so far as the appointment of analysts was concerned, but not to insist on the appointment of inspectors, nor, on the other hand, to insure that a sufficient or indeed any number of samples should be analysed. In many cases, although the Act was to a certain extent in force, the number of samples examined was so small as really to have no influence on the character of the supply of the district. Another point hinted at by Dr. Bell was how far it was possible to secure that the articles submitted to the analyst were the actual articles supplied to the public in the neighbourhood. Here of course came the question how far the services of the inspector were neutralised by the publicity of his office, and how far it was desirable that samples purchased by private consumers should be analysed. Then again there was another

point, whether the punishments inflicted on offenders were adequate, and whether the same limitation to the reduction of the fine as applied in the case of offences against the Revenue Laws should not also apply to repeated convictions under this Act. Another point which naturally suggested itself was, how far the Act should be increased or diminished in stringency; for instance, as Dr. Bell told them, beer was qualified only by this definition, that it must be the article ordinarily sold under that name, and the question was whether matters should be left in that state with regard to beer, and if so, whether it might not be desirable to leave them in the same open state with regard to other articles of a more or less manufactured nature. It might or might not be right in the case of beer, but if it were, the question arose, why should it not be right for butter or for cheese? If a tradesman were allowed to sell as beer anything which was held to be the article ordinarily sold under that name, why were butter and cheese not to be equally the articles ordinarily sold under that name? It might be desirable to put these latter articles on the same footing as beer, or, on the other hand, it might be desirable to put beer on the same footing as them. Another question was, how far the use of chemical agents as preservatives was allowable. They knew that beer of very high repute did contain the chemical substance called bi-sulphite of lime, and he did not know that any brewer had been interfered with for using that article, but, on the other hand, they knew that dealers in milk had been interfered with for using boracic acid, which seemed to be an anomaly. In the same way with regard to bread. At one time an artificial powder made of tartaric acid and bi-carbonate of soda was largely used in making bread, and afterwards bi-sulphate of lime was used as a substitute for the tartaric acid; and at one time bread was made largely in the neighbourhood of Manchester, in which carbonic acid gas was made by the introduction of pure super-sulphate of lime and carbonate of soda. It was a question whether chemical agents of this kind should be allowable and to what extent. Another poin which he would venture to put forward was,

how far the Adulteration Act might be extended so as to include food for cattle, and how far, moreover, the work of public analysts might not be directed to a considerable number of articles of food which were rarely, if ever, now examined ; such, for instance, as syrups and fruit essences, many of which were made from artificial chemical products, and, again, the class of mineral waters. Another point of some delicacy, but of considerable importance, was how far the mode of settling differences of opinion or differences of statement between analysts was altogether satisfactory, or how far it might be possible or desirable to improve it. The mode adopted of referring these matters to the Inland Revenue Chemical Department was no doubt a very unusual method ; in most other cases a chemist on one side, and a chemist on the other set forth their different opinions, and a judge or jury had somehow or other to decide the matter between them. Occasionally these opposite views were referred to some particular expert to act as referee, but it was only done by the consent of both parties. In the case of adulteration of food there was an official referee, and on the whole they would all feel that he had done his spiriting very gently. Then came the very important point raised by Dr. Bell, as to the desirability or not of fixing the limits of quality in such articles as milk and butter, which though genuine were susceptible of very great variations in quality, so that putting aside the idea of legal prejudice, a customer might really be more prejudiced by buying an inferior genuine article than he might be by buying articles of high quality subjected to a greater or less amount of adulteration. Dr. Bell had already intimated his view on this point, that the adoption of limits of quality might lead to some difficulties, but other persons might have a different opinion. A question would arise, how far any regulation of this kind would limit the supply if, as had been suggested, the rise of $\frac{1}{2}$ per cent. in the non-fatty solids of milk would really have the effect of reducing the supply by 10 per cent. ; no doubt they would all agree that it was very undesirable to do so, but opinions

might differ whether or not it would necessarily have that effect, and whether the inferior qualities of milk might not be made use of in some similar way to what was called the mingling of brands in other articles. No doubt Dr. Voelcker would be able to give some idea if a limit of quality were fixed, whether it would interfere with the abundance of supply. Then would come another question, how far it would affect the average result. It might reduce the highest qualities of milk to the lower standard, but even if that undesirable effect resulted, the influence might on the whole be good by improving the general average. At the same time it might be possible to have in the market more than one quality of milk; they might even perhaps suppose that milk dealers would sell milk guaranteed to be of a certain quality with a certain percentage of non-fatty solids, a certain amount of cream, and so on. Then came another point also raised by Dr. Bell, the difficulty of analysis by reason of the variety of natural substances, and the question, what should be the standard taken in the case of milk and in the case of butter. They all knew that very considerable differences of opinion had arisen, and had led to some rather warm discussions with regard to what should be the standard which should serve as the means of expressing the proportion of water added to any particular milk. Then came the question of different modes of analysis, and it would be for the meeting to decide whether that subject should be discussed; but they might certainly consider the point whether it was desirable, in all cases where practicable, to obtain results which were expressible in exact percentages and not rely on mere comparative results. Another point was that some of these adulterants were added with the object and result of improving, as a marketable and eatable article, the materials of the food to which they were added, and a question of considerable importance, how far these effects might be produced without the aid of adulteration; for instance, in the case of bread, they all knew that alum aided in producing a much more presentable loaf than could be obtained with-

out it, but the question was how far could that appearance be obtained without the use of such an objectionable adulterant.

Dr. VOELCKER said it was impossible to discuss the many points to which the Chairman had alluded, though they all needed discussion before any amended Act could usefully be brought in. On the general point he would venture to express the opinion that a very great deal of good could be done if the adulteration of cattle food were included, for no one could have an idea of the extent to which the adulteration of cattle food was systematically practiced in England, more especially linseed cakes, which were so largely used for the production of milk and fattening of cattle. It was true that in late years, owing to the Royal Agricultural Society of England, who had taken a very bold step in some cases of publishing the names of offenders, the adulteration of cattle food had somewhat diminished, but it still existed to a great extent. Taking linseed, rape, and other cakes of a definite character, leaving out mixed cakes, which were professedly sold as mixed, a very large proportion were adulterated. In the same way, feeding meal, such as refuse from rice mills, Indian corn flour, and the refuse of starch manufactories, was very greatly adulterated, and a deal of harm was done to cattle. Every year he got a great many samples of rice meal, adulterated with gypsum and bran and pollard, which was sold for feeding pigs, and of course filled them. A good many cows, too, were yearly poisoned by adulterated rape cake; one-half of the linseed cakes, even those which professed to be pure, were not genuine pure cakes. At the same time there was no difficulty in obtaining reasonably, commercially pure linseed, containing not more than 5 per cent. of foreign matter, such as small bits of sand or seeds. A few years ago there were a few mills which produced pure linseed cake, but at present they were more numerous, still a great deal of good would be done if the Act were extended to cattle food. In his capacity as Assistant in Chemistry to the late Professor Johnston, of Edinburgh, subsequently to an experience of

fourteen years at the Royal Agricultural College at Cirencester, and his experience as Consulting Chemist for twenty-six years to the Royal Agricultural Society of England, had brought him in close contact with all matters in connection with dairy farming and the production of butter and cheese, and he would therefore say a few words on the production of milk. It had been stated that it would be a great advantage to fix a definite standard quality for milk, and in some measure it would be, provided it were fixed high enough, and that standard were fixed on a reasonable and sound basis, not, as had been done, on questionable analyses and experience. The present standard by the public analyist was too low, and he was of opinion that from one-half to three-quarters of the milk sold in London and other towns was partly skim milk, not the natural substance as the cow furnished it, especially in the strawberry season, when garden parties were common, because a good deal of the cream was taken off. At the present time very reasonably good milk might be expected, not of course such rich milk as that furnished by Jerseys and Alderneys, which often contained a much higher percentage of fat than the maximum mentioned by Dr. Bell; but of course you could not expect to get that at 4*d.* or even 5*d.* a quart. A large percentage, however, of pure milk was partially skimmed, owing to the fact that public analysts had fixed the standard, which they had published or made known amongst the trade, at 2½ per cent. of fat; on the other hand, 9 per cent. of solids, not fatty, was too high, and this figure had been fixed on the basis of an imperfectly dried milk residue. Of course, if the water were not all driven out, the residue would be larger than it would be if it were dried perfectly. The difficulty of fixing any standard arose from the fact that milk was subject to such great variations. At certain times of the year milk was poorer than at others; for instance, in the spring of the year when the fresh grass was coming in, being very watery, it would not produce such rich milk. Still, with all these variations, a certain minimum quality ought to be insisted

upon, and he thought that 3 per cent. of pure butter fat and 8 per cent. of solids not fat, would be a very good standard, and few dairymen would find fault with it. Another danger in fixing a standard was that dealers would work up to it. He one day asked the dealer why he did not give more cream, and the reply was that he was compelled by competition in the trade ; that he could give milk with 3 per cent. of cream, but the others did not do so, and therefore they kept it to the standard. One man said they could not go on with the business if they did not keep a chemist on the premises. He was by no means unfriendly towards his own professional brethren, but he could not see the necessity of having an analytical chemist employed to work up to the standard required by public analysts, and thought it would be much better to have the milk pure. As a rule, milk dealers took care of themselves, and did not supply the public with richer milk than they were compelled to. He did not think Dr. Bell was quite accurate in saying that no cheese partially made with butterine had as yet found its way into the market. He was sorry to say a good deal did so, and the exportation from America of oleomargarine cheese was very considerable and increasing. There was something to be said for this cheese ; he had himself tested it, and as long as it was sold for what it was there was no great objection to it. The same with regard to the oleomargarine used in the manufacture of Dutch butter ; about 100 tons were exported every year to Holland, manufactured there, and came back to England as the best Dutch butter. So long as an article of food was sold for what it was, and the materials employed were of a wholesome and inviting character, he did not see any objection. A great deal of cheese in England was unsaleable, especially that made in localities where there was no sale for the milk. There was great trouble in disposing of the skim-milk, and skim-milk cheese only fetched from $3\frac{1}{2}d.$ to $4d.$ a lb., but with the addition of oleomargarine it could be made into cheese which could be sold for $8d.$, which was certainly a more profitable way of disposing of it, and perhaps no great

injury was inflicted on the public. The great desideratum was that the thing should be sold under its right name. In conclusion, he would offer a word of caution to analysts, who he had no doubt had been doing a great deal of good. The adulteration of food had certainly greatly diminished, owing to their exertions, and their duties were more and more recognised by those in authority. It was from no wish to find fault with them that he remarked that perhaps a little more caution would sometimes be desirable ; that they should not jump to a conclusion simply because they found a certain reaction was produced, that a certain thing was present which had really nothing whatever to do with the character and value of the article under consideration. Only a few days ago a sample of cream had been referred to him which had been pronounced by the public analyst to be adulterated with starch, and of course his impression was that starch in the shape of a thick paste might have been used with the view of making the cream look thick. He tested it in the usual way with tincture of iodine, and found that the quantity was so small that he knew at once no starch could possibly have been added to the alleged adulterated cream. Taking several portions, in some he found traces of starch, and in others he did not, and examining it under a microscope, he found that where he got a starch reaction there was a solid starch granule or so, and it struck him there could not possibly be any appreciable quantity of starch, and that possibly it might be due to the fact that the cream had been strained through a linen cloth, and on further inquiries he was confirmed in his opinion that that was the right explanation. In another case which recently came under his notice, a gentleman sent him some cream which he said threw down a purple colour, and he thought something dreadful had happened. However, under the microscope and subsequent chemical tests, he readily found out that there was some aniline dye present, and, writing for further information, it turned out that the dairy-maid had strained the milk through a red-coloured calico. In such cases, to jump to the conclusion that some frightful

thing had been practised on the cream would be totally wrong. At the same time he did not say that the use of red-coloured calico was not objectionable.

Mrs. SEDDON asked if there was any society for the purpose of paying the expense of analyses for poor people who could not afford to do so, and also if there was a public analyst at Ramsgate.

The CHAIRMAN said there was a public analyst for Ramsgate, who lived at Canterbury. There was no society for the object named.

Dr. DUPRÉ said that public analysts had so rarely the opportunity of bringing their case before the general public that he gladly availed himself of this opportunity of setting forth their side of the question, and he hoped there might be present both manufacturers and dealers who would give their opinion from the opposite side. There was no doubt that adulteration had greatly diminished, more particularly in such articles as came more under the operation of the Act, such as bread, milk, spirits, and coffee, &c., but the effect of the Act had not been anything like as great as it might have been, for various reasons. First and foremost was the apathy of the general public. The Act was passed primarily for the protection of the general public, and secondly for the protection of the honest trader, to protect him against unscrupulous rivalry; but unfortunately this primary object of the Act seemed to be forgotten by many persons, and public analysts as a rule received no support whatever from the general public, either by having samples brought to them to be analysed or by an expression of opinion in favour of a proper carrying out of the Act. The result was that the analyst found himself opposed by those who practised adulteration, not by any means a small class, and also by certain associations, some old and some new, which ought to look on the analyst as the greatest benefactor, his object being to suppress adulteration, but they did not seem to do so, and consequently, whenever any one of a particular trade was attacked, they went in with counsel and witnesses and all

the machinery of the law to stop the prosecution, and the public analyst, not having any support, often failed. His real position was often misunderstood by the public and by the tradesmen directly interested. His sole function was to analyse any article of food, drink, or drug brought to him by either an inspector or by any one appointed under the Act, or by any one of the general public who complied with the provisions of the Act, which were to the effect that, at the time of purchase, he must tell the dealer that the article was to be analysed, and must offer to divide it into three portions. The public analyst had nothing whatever to do with buying the article, or with any subsequent prosecutions; he simply gave his certificate, and, if necessary, he must be ready to give evidence as to the truth of the certificate in the witness-box. He had nothing to do with any prosecution, and in fact occupied a position of absolute neutrality. The second cause why the Adulteration Act was not as effective as it might be was on account of the low fines frequently inflicted. He could not illustrate this better than by referring to milk, which was an article of primary importance, on which depended the lives of thousands of children, yet it was one of the most largely adulterated, owing partly to the ease with which a man might go to the pump or water-tap. This only seemed to him to render it desirable that, if adulteration of milk were proved, the fraudulent dealer ought to be punished severely. But what did they find? If a man added only 10 or 20 per cent. of water, he was fined 5*s.* or perhaps 10*s.* What was the meaning of the fine of 5*s.*? it meant simply the sale of 12 quarts of water in the shape of milk, so that, if he added 10 per cent. of water, the sale of 15 gallons of adulterated milk would pay the fine. Now, in the nature of things, it would be quite impossible to frequently analyse the milk of the same dealer; it would be scouted as persecution, and the result was that, before the milk inspector came round again, the fraudulent dealer had long ago recovered his fine, so that such a low fine, instead of a deterrent, was actually a premium on adulteration. To

show what might be done if the public took more interest in the matter, he might say further, that in his district inspectors used to be in the habit of going round, and when he had been, in two successive weeks the milk used to come up to a very good standard. It was once suggested that they should go on the Sunday, and the result was that the adulteration of milk, which on week days was one in six for several years, turned out on the Sunday to be six in seven ; almost every sample bought on the Sunday was adulterated. Next Sunday every sample obtained was genuine. He had not the slightest doubt that if the public would occasionally bring samples to the analyst for examination, this adulteration would be considerably checked. With regard to the standard, the society of public analysts had never fixed a standard, they had fixed a limit below which no milk should be considered genuine. There was no question about it that the fixing of such a limit was a great difficulty ; milk did undoubtedly vary within tolerably wide limits, but this variation was confined to a very few animals. You might occasionally find the milk of a single cow which fell very much below the limit, whether the cow was in a state of health or not, or had been properly fed, he would not say. But was it right that the general public should be deprived of their proper quality of milk because sometimes a single cow gave a milk which fell below that standard. If it were the case with a single cow, it was never the case with a whole dairy. He desired to speak with the highest respect of the officials of Somerset House, who did a difficult work with remarkable ability, and, on the whole, with considerable success ; but on the question of milk he could not help thinking they had made a mistake, and that it would be a great injustice if Londoners were restricted from getting their milk up to the standard of 9 per cent. Another point was this, the word "adulteration" was not mentioned in the Act, it simply said the article should be of the nature, quality, and substance demanded, and it would be well if the Act throughout kept to that definition, and did not require of the analyst an impossibility ; but, unfortunately, the

schedule appended to the Act, which gave the form of certificate which must be used by the analyst (and must be literally followed, for if a single word were left out it might lead to objections being taken and a failure of prosecution), said the analyst must certify that such and such a foreign ingredient was present in such and such a proportion. Now, he might say, without fear of contradiction, that though it was often possible to state that a substance was not of the nature, quality, and substance demanded, it was perfectly impossible to state what was the nature of the ingredient added, and still less to say what was the absolute quantity added. He thought, therefore, the Act should be amended in that respect, and that the analyst should have the option of stating that the article submitted to him was not of the nature and quality demanded, but that he was not able to state the exact nature and absolute quantity of the article added. Take the case of wine; it was comparatively not a difficult matter to say whether the colour of red wine was genuine or not, but is was nearly almost impossible to say what was the nature of the colouring matter added; in some cases it could be done, but in others it could not, and therefore, in such a case the only option the analyst had was to pass over such an article, for if he varied from the form of certificate, the prosecution would fail. A great many articles had to be passed simply because the analyst was unable to state what was the quantity of the adulterant. There was no doubt the present form of certificate was a great stimulant to research, because no one liked to fail, and every one was anxious to devise methods which would enable him to state what was the exact nature and absolute quantity of the adulterant. But as long as that was not possible, he did not think the law ought to ask them to state what was really an impossibility. Dr. Voelcker thought public analysts had raised the standard of milk too high in one respect, and too low in the other, namely, in the cream; but why had they done so? Because they were not sufficiently supported by the public, and if the unfortunate analyst gave a certificate that milk

containing 2·5 or a little cream was adulterated, down came some association and a number of witnesses, to prove clearly that that was all matter of necessity or of accident, and that if you went on taking milk from the top of the churn, you naturally went on skimming it, and if you came to the bottom, the cream must have been removed. It might not have been removed fraudulently, but still it had been removed, and the result was that the public had to take bad milk. Everybody could skim milk, but it need not be done, and if a dealer were thoroughly honest he could easily mix his milk before the sample was taken.

He had made many experiments, showing that if you had milk with as much as 5 per cent. of cream, you could go on dealing out four or five gallons without reducing the cream. With regard to the question of whether anything should be added to preserve articles of food, at first sight it seemed quite right to allow it, but on a little further consideration grave doubts would be engendered, whether in the case of milk that was right or not. Milk was fortunately an article which had to be handled and treated with very great care, and unless the dealer were cleanly in all his apparatus and business, the milk would all turn sour. But if he were allowed to use anything to keep the milk, the public would lose to some extent that safeguard, and business might be conducted in a slovenly manner, and the milk kept in dirty rooms, without showing it, by turning bad. He thought this property of milk was very fortunate, and one of the great safeguards ; for if you had milk which kept a reasonable time, it was an indication that it came from fairly healthy cows, and had been properly dealt with. In the second place, the milk dealer could not skim much cream unless he used a centrifugal machine for making the milk turn, and he noticed in his district that whenever they had milk with a sufficiently low proportion of cream, there was generally boracic acid in it. He had no doubt that had been added in order to allow of the milk being kept standing sufficiently long to skim it without running the risk of its turning sour. With regard to spirits, it was

often said that young spirits were injurious to health, because they contained fusel oil, but there was absolutely no evidence to support it. Nobody had ever yet proved by analysis that young spirit contained more of this supposed deleterious ingredient than the old. Some years ago he had to analyse some Cape Smoke and Sanchou from China, which played great havoc with the English sailors there; the idea was that these deleterious effects were due to an improper proportion of fusel oil, but it turned out that it contained a smaller proportion than English whisky. Some years ago there was some considerable discussion on this point in Sweden. The Swedes seemed to be given to a great extent to brandy drinking, and it was stated in public that the many injurious effects were due to drinking fresh spirit with fusel oil in it. A commission was appointed to examine into the matter, but there was no evidence to prove that it was due to fusel oil, but that as a rule the young spirit was so much liked by the populace that they drank considerably more of it than they did of the old, and therefore the injurious effects were due to the increased quantity taken rather than to the bad quality. He hoped this Conference would to some extent arouse the interest of the general public on this question, for he was firmly convinced that it was only by a fair co-operation of the public with the public analyst that adulteration could ever be suppressed.

Mr. WIGNER (President of the Society of Public Analysts) said his own opinion was that Dr. Bell had taken rather too favourable a view of the action of the Act up to the present, and although he agreed with him that it had done a considerable amount of good, he did not look on the amount of good yet done as being nearly sufficient for the machinery put into play. It was something very little short of a disgrace to a country like England, after having an Adulteration Act at work for eight or nine years, to find the average of adulterated articles sold should be 17, 18, or 19 per cent., varying a little with the class of goods. Dr. Bell had quoted from the statistics given in a recent book

of Mr. Herbert's, but he was sorry to say those statistics were not so full as was desirable, and in some respects they were not by any means accurate. He had a few other statistics which would illustrate that point. Taking the seven years from 1875 to 1881, the reduction in the percentage of adulteration had only been 18·1 to 16·6, a very unsatisfactory result for seven years' work. Taking, again, the adulteration of milk, it had increased since 1879 by nearly 3 per cent., and grocery, the next important article, only showed a reduction of 2 per cent. It was clear therefore that an alteration in the Act was wanted, and he very strongly advocated that alteration, taking the form of schedules, or standards of purity, of such a character that the very inferior articles, such as some speakers had referred to, should be excluded, even at the risk of a little inconvenience. For instance, there was just as much reason for excluding from retail sale milk which had only 8 per cent. of solids, not fat, if produced by an underfed or badly kept cow, as if produced by the actual admixture of water. If the cow were incapable of producing better milk, then she ought to be sent to the knackers, rather than be used as a milk-producing machine. He thought they might learn something from other countries. England took the lead with the Act of 1875, but that was the result of a compromise, when the effect produced by the Act of 1872 had been too severely felt by tradesmen. It was said that that Act acted harshly, and no doubt it did in some instances ; a Committee of the House of Commons was appointed, and the result was the Act of 1875 ; but it was introduced with this remarkable clause, that if any article sold was sold in accordance with the usage or custom of the trade, the vendor should not be proceeded against. That, which was struck out in Committee, was the basis of the whole Act, and was the reason why no standards or limits were introduced into it. Amendments were gradually introduced during the passage of the Bill through the House, and an effort was made, not only to introduce standards, but also to extend the Act to cattle foods, but this was defeated by the agricultural

party. More than two-thirds of the United States were under Adulteration Acts, and they were all based on an uniform draft. There was in addition a national law, and, with two exceptions, all those States had limits, and, with one or two exceptions, all of those limits were those laid down by the Society of Public Analysts, so that throughout more than one-half of the United States it was illegal to sell milk that contained less than 9 per cent. of solids not fat, or with less than 2·5 per cent. of fat. Granting that Dr. Voelcker was correct, and that the fat standard might be raised, he had heard no complaints from America with regard to it. Inferior milk was no doubt used to make inferior cheese, and the public were, he believed, fairly supplied. Now, turning to France, the Parisian Act was a municipal one, much more stringent than ours, and much more thoroughly enforced, but the same standards had been adopted. Although that Act had been in operation for about five years, he had not heard of any case in which a successful appeal had been made against the conviction, which showed that in Paris the matter was looked upon more seriously than it was here. In that city, with a population less than half of that of London, there were twenty-four inspectors, who did nothing else than take samples. Their course of procedure was to go in couples to every shop, to examine every canister, jar, and package in the shop, selecting that which they thought fit, and taking it to the laboratory, and leaving the others; and the number of samples examined was from 800 to 900 a month, or about 10,000 every year, while in London we were content with 1200 or 1400 in the same time. The result of that on milk was, that in Paris the average of the adulteration was only 2 to 3 per cent.; while the average adulteration at the present day in London was 17 per cent. adulterated with water, and at least 17 per cent. by skimming; or, adding the two together, 34 per cent. of milk was adulterated in one way or the other. That formed the strongest reason for suggesting the use of a limit, and that it should be higher than the one adopted by Dr. Bell, who

had adopted his limit on the basis of poor cows being legitimate machines for manufacturing milk. He thought most decidedly the other way, and that proper milk should be the milk of healthy fairly well-fed cows. The section which provided for the examination of tea in bond had certainly been of service, and the adulteration of one or two other things had been entirely suppressed. The effect of the change made in 1879, by which spirits had a fixed limit, had also produced an improvement. Passing to the important mode in which the Act was enforced, he would remark that the Local Government Board had power to appoint analysts, if the Local Authority refused to do so, but they had no power of enforcing any penalty if the Local Authority did not appoint; and, after they had appointed an analyst, they had no power to pay him any salary, and therefore the Local Authority could, and did, snap their fingers at the Central Board, and the consequence was that analysts were not appointed, because their appointments would be mere sinecures, as they would have neither work nor pay. The same thing applied to the number of samples which were purchased. It had been put forward several times by the Local Government Board that one sample per 1000 of population ought to be purchased every year—certainly a very moderate estimate—but that was something like sevenfold the actual number. The certificate of analysis was unquestionably a most complicated and cumbrous document. It was originally worse, but it was slightly improved in its passage through the House; but, unfortunately, that certificate was not made incumbent on the chemists at Somerset House, when giving reference certificates, and, as the result of that, differences had arisen in many cases. The Public Analyst, for instance, was compelled to state whether any change had taken place in the character of the sample which would interfere with that analysis, and it was notorious to everyone that, in nine cases out of ten, samples of milk became decomposed when sent for reference analysis. That fact ought to be put in the certificate, because it had an important bearing on

a second point that that certificate had to say—not as they did now, that the analysis could, or could not, be confirmed, but to say, in many cases, there was nothing to show whether the analysis was right or wrong. He believed Dr. Bell would agree with him, that many cases occurred where they were utterly unable to say the Public Analyst was right, but were equally unable to say that he was wrong; and if that were the case, the weight of evidence should certainly go in favour of the analysis made when the article was fresh, and the conviction should stand, rather than a man who, in all probability had been guilty of watering the milk, should escape. The question had been raised as to the limitation of supply which would arise from raising the standard, and his feeling was that that limitation would be very small. It was quite true that some of the milk used in country districts—particularly at a great distance from London—which was used for manufacturing condensed milk and for cheese, would be withdrawn for those purposes. But the milk could just as well come as an imported article; and if the area from which the milk supply of London was drawn were enlarged by a very few miles—and it already extended to an average distance of thirty-eight miles from the outskirts—it would give the supply required to sell all genuine milk, instead of part genuine and part water. The sale of genuine milk was larger than was supposed, because the sale of high-priced milk was larger than was generally thought to be the case. He was sorry to hear Dr. Voelcker's remarks with reference to the necessity for more care on the part of the public analysts, especially bearing in mind that in the two cases which he cited—only one of which was the case of a public analyst—it would clearly have been the duty of the analyst to have condemned the cream. In the first case it was true it contained only a trace of starch, and the supposition was no doubt correct that it was derived from an unwashed piece of cloth or calico used to strain the cream; but if the dairyman had allowed a piece of calico dressed with starch, or other impurities, to be used to strain

the cream, he deserved to be convicted under the Adulteration Act, and, if it were not wide enough to catch him in one way, it ought to be wide enough to catch him in another; and the same thing was certainly true in the case in which linen coloured with aniline had been used. His feeling was that they should pass some resolution which should strengthen the hands of those who would have to take it in hand, if an amendment of the law were considered desirable or feasible.

Professor ATTFIELD, F.R.S., said he should address himself to one only of the points mentioned by the Chairman, and that was as to the proportion of articles of food and drink which were said to be adulterated. The public drew rough conclusions from what was said at Conferences like that, and one very rough conclusion they would draw was that of any articles of food and drink which they had to consume, 15, 16, or 17 per cent. were adulterated. Now, he should not like it to go forth to the public that that was true; the truth was, that of the articles which had been examined by the officials under the Adulteration Act, 15, 16, or 17 per cent. were simply said to be adulterated. Now, taking the number of different articles placed on our breakfast, dinner, and tea tables, he thought they might say there would be 20 or 30 different articles so presented in the course of the day, and in the course of a year many thousands of distinct purchases were made for the household. Now, was it to be assumed that of those thousands of articles, 17 per cent. were adulterated? As a chemist, having had 25 years' experience of analyses of articles of food and drink, he protested against any such assertion. He had examined vast numbers of articles of food and drink, and a still larger number of drugs, and his deliberate conviction was that not one in 1000 was adulterated, and he could give, not only his experience, but statistics to support it. For the last ten or twelve years he had been the chemical adviser of a body of traders who were liable to be charged with adulteration, and he consented to advise them whenever they might be threatened with a prosecution.

In some 25 cases in which they had been so threatened he had advised that about 20 should be defended, and in the course of defending the actions in these 20 cases, where the matter had been brought before the various impartial tribunals to which such matters were referred, the prosecution of 19 had been dismissed. In several of those cases it had been a matter in which the local officials on the one side had been put into the witness box, and himself on the other (but he had to give no evidence at all), in which a few questions put by the counsel for the defendant to the witness for the prosecution had been sufficient to upset the case. He made no charges against any man, but at the same time no man was perfect. It was quite possible in those 19 out of 20 cases there might have been wrongful adulteration, but he could only say that the independent tribunals had said it was not so. Now, if out of 25 cases brought before him he was able to succeed, so that in four-fifths of them the prosecution would be upset, and that practically in the whole of those cases the defendants were found not to be in the wrong, if one were to draw an inference, it would be that out of 15 per cent. of cases of alleged adulteration you ought to take off about 12, leaving 1 or 2 per cent. of possible cases of adulterated food. He would not, however, make any such inference, for he questioned the wisdom of drawing any conclusion whatever from these figures.

Mr. HEHNER said, after the somewhat vigorous remarks of the last speaker, it would not do for public analysts to let the matter stand without some reply; for although Professor Attfield had disclaimed the idea of bringing charges against public analysts, yet with the fact that every year something like 16,000 to 18,000 samples were analysed, and something like one-fifth or one-sixth were declared to be adulterated, if they were told that only 1 in 1000 was so, the implication upon public analysts was a somewhat heavy one. This Act had been in operation about 10 years, and every year 16,000 to 18,000 analyses had been made, making a total of close on 200,000; of those 200,000 something like 30,000 were declared to be adulterated, on

which prosecutions took place, and according to the hypothesis now put forward, wholesale injustice must have been inflicted. It was notorious that statistics could prove anything, but these analyses were not made to produce statistics. The aim of those who bought samples and submitted them for analysis was to do the greatest amount of public good for the least amount of money, and therefore the aim of inspectors was to catch as many adulterating tradesmen as possible. If the inspector went about, and only bought the best samples of food, and the analysts reported that out of every 100 samples he received 100 were genuine, the public would be misled, and the authorities would soon direct that no further operations should be undertaken under the Act. Therefore the inspector in his district did not endeavour in buying samples to get an average number of adulterations, but he tried with the small amount of money allotted to carrying out the Act to do the greatest amount of public good, and that was only to be done by trying to get at those who adulterated, not at those who notoriously did not. Professor Attfield seemed to be exceedingly fortunate. Of course he accepted what he said, that he only got 1 sample out of 1000 adulterated, but considering that there were something like 100 public analysts, and many thousand samples were examined, nobody with any fairness of mind would for one minute admit that this wholesale injustice had been committed over so many years; and therefore it only followed that if Professor Attfield had been so fortunate as to escape getting adulterated samples, someone else must have had them in an increased degree. That was specially the case with the poor people who bought their goods in pennyworths, or small quantities. It would be as easy to buy 100 genuine samples as to buy 100 adulterated, and therefore he admitted the statistics did not go for much; they only showed that out of so many samples examined 16 per cent. were found to be impure. Again, although it was shown that the adulteration had not greatly diminished in percentage, yet every public analyst

had noticed the decrease in the amount of adulteration. Five or ten years ago, samples of milk were frequently met with containing from 25 to 50 per cent. of water ; but now it was exceedingly rare to get anything which contained 20 per cent.—10 to 12 per cent. was much nearer the average amount of adulteration. On the whole, adulteration in our days meant something quite different to what it did ten years ago. Fifteen years ago, vermilion, chromate of lead, and other poisonous substances were frequently used, but in our days poisons were no longer met with ; in fact, as had been said, only cheating and not poisoning now took place, and if that was not an improvement effected by the Food and Drugs Sale Act, he did not know what could be. It was notorious that altough the Local Government Board could insist that an analyst should be appointed, there was no power to insist on samples being purchased for analysis, and there was a very considerable portion of the country in which no samples were examined. In one town that he knew the Act was not enforced, whilst in the country all round it was. In the country no adulterated articles would be sold, but as soon as the milkman passed the borough boundary, he could put his can under the nearest tap, because he knew there was no inspector about. In that respect the omission of compulsion in the Act did a great deal of harm. It should be made compulsory, not only as to the appointment of analysts, but in the purchase of samples, and in the proportion of samples to be purchased. It was not sufficient to get about ten samples a year, and even that was more than was done in some places. It must not be left entirely to the governing bodies, whose interest it frequently was not to have any samples analysed at all. He could mention a number of boroughs where there were a majority of people in the Town Council who dealt in food and drugs, and although an honest dealer might not mind having his articles analysed in some boroughs, the Act was not very strictly enforced. Dr. Bell had been extremely complimentary to public analysts, and on the other side he must acknowledge the amount of consideration which had been

shown by the Appeal Court to which their cases were referred, and he was happy to say that there was a very considerable agreement between that Court of Appeal and Public Analysts, more so even than appeared. Every year, out of 25 or 30 cases referred to Somerset House, the analyses in only about half had been contradicted, but small as that proportion was, it was in reality much smaller, because it was frequently not a question of fact at all which was in dispute between the Public Analyst and the Court of Appeal, but simply a question of opinion. Nearly all cases in which disputes took place had been those of adulterated milk, and it frequently happened that the analyses of the analyst agreed entirely with that of Somerset House, only he came to a different conclusion from the figures. Of course, with so many thousand analyses there might be mistakes. Analysts were quite as fallible as other people, and perhaps more so, but the proportion of mistakes were very small, and there was this slight grievance, that they had to refer their analyses to a court of appeal, which really had far less experience in that particular kind of work than they had themselves, seeing that they analysed every year about 6000 samples of milk, whilst the Court of Appeal perhaps only analysed 600 altogether.

Professor DE CHAUMONT thought they might congratulate themselves, in spite of the partial failure of the Adulteration Act, that so much had really been attained. He could not take the roseate view which had been taken by one speaker, and say that in one article out of a thousand submitted to him for analysis there was no adulteration proved. In milk alone the experience of any analyst would have proved that the proportion was larger than had been stated. With regard to the question of how they should deal with cases of alleged adulteration, he quite agreed with what had been suggested by more than one speaker, that a great deal of loose statement was made with regard to the presence in articles of commerce of adulterants. For instance, in his own neighbourhood, Netley, he had been told that a good deal of the beer sold was adulterated with tobacco, but

although he analysed seven samples, he had been unable to detect the presence of tobacco, except in one case, and in this instance he proved conclusively that it got in through the man carrying some tobacco in his pocket. One important point to consider was, whether they should deal with articles as avowedly prepared articles of commerce, as was understood to be done in the case of beer, or whether they should deal with them as articles that ought to be provided in a pure state. As a great number of articles were allowed to be used in the manufacture of beer, it was hardly possible to lay down any possible standard of what beer ought to contain, but this did not apply to butter or cheese. Milk ought to be sold as it came from the cow. At a Milk Conference that he attended at Gloucester, one gentleman suggested that milk should be taken as an article of commerce at a certain standard, and he considered it very hard if he had some cows yielding a particularly rich quality of milk that he was not allowed to take the cream off and sell the milk, which would then be equal to the usual standard. No doubt this would be very convenient for the trade, but exceedingly dangerous to the customers, as they had no security with regard to the means adopted, because water might be taken from the most polluted well in the country. As to butter and cheese, he thought they should be sold as pure articles. The Adulteration Act might be amended in this way, that no mixtures whatsoever with articles which could be provided as pure articles ought to be allowed at all. If coffee was sold under the name of coffee, it ought to be sold as pure coffee, and if people desired to use chicory, by all means let them buy it, and mix it themselves. The same principle might be applied to other things. The difficulties which the Adulteration Act had met with were many, and no doubt in earlier times one of the difficulties was the different modes of analysis, the uncertainty of the application of the guess made, and the necessary inexperience of analysts. All those were stumbling-blocks in the earlier days, but these for the greater part had now been got over. The Adulteration Act was above the standard of morality

of the nation of the present time, in fact it was too respectable an act for general outward application. He said this advisedly, for there were many tradesmen who would certainly scruple to put their hands into a person's pocket and take out sixpence or a shilling, who had no hesitation in putting water into milk or chicory into coffee. The immorality of the act was the same, but the public did not seem to think so, and magistrates seemed to look upon it as the custom of the trade to cheat, and that therefore the public ought to be content to be cheated. If a man were fined for adulterating milk one day, and again brought up a day or two afterwards, it was looked upon as persecution ; but supposing a man was punished for picking pockets, and he immediately resorted to the same practice, it would not be considered persecution if the police again took him into custody. Until they reached the point at which they could make it felt generally that adulteration was a distinct wrong against society, and not only a wrong, but a disgraceful wrong, there was not much chance of getting the Adulteration Act carried out to its full extent. In Paris and other parts of the Continent the Act was carried out in a more rigid way than in England. If public opinion could only be educated up this point, that a man who had been convicted of adulteration was publicly disgraced, then and not till then would adulteration be put a stop to.

The Conference then adjourned.

Conference on July 15, 1884.

The Conference resumed at 2 o'clock.

Dr. Muter said, in renewing this discussion he should not descend into the personalities or the contentious matter which had been brought up in the course of the discussion by those speakers who seemed to wish to run down the public analysts. Without going through the whole of the heads mentioned by the Chairman, he proposed to inquire first of all whether adulteration really existed to a marked extent before the passing of the Act of 1872, and whether that had been checked to any extent by the passing of that Act; secondly, he would inquire whether the Act, as it at present stood, ought to be amended, and in what direction, and whether standards and limits should be adopted; and lastly, he would reply briefly to the remarks made by one or two gentlemen yesterday. In the first place, on the question whether adulteration existed before 1872, and was that adulteration deleterious or merely commercial adulteration. Dr. Bell had already commented on the reports of the Lancet Commission and other instances in support of the contention that adulteration did exist. Now he was one of the two or three remaining living analysts who really trained themselves to food analysis before the passing of the Act, and who had had practical experience in connection with a commission similar to that of the Lancet, viz., the Food Journal Commission. Looking back to the figures of 1870 and 1871, he found that out of twenty-three samples of coloured sweets then examined all over London by the editor of the Food Journal, thirteen were coloured by a coating of chromate of lead, and three

contained streaks of vermilion as well. As regarded mere commercial immorality, out of forty-seven samples of coffee bought as pure in that year, thirty-one were more or less mixed with chicory, whilst in seventeen cases the chicory itself was mixed with something else. He mentioned these facts to show that these things really existed—it was not mere hearsay, and he also asserted that the passing of the Act had produced a very great improvement; whereas in the districts in which he held appointments during the first few years after the passing of the Act, they could still get hold of these tainted sweets, they could not now do anything of the kind. For the past four years, out of many hundreds of samples he had examined, not one contained any deleterious colouring matter. He would even go the length of saying that the Act had entirely stamped out all deleterious adulteration, and that what now took place was rather in the nature of commercial immorality. In looking over the books of the South London Public Laboratory, where the business was done for seven districts and boroughs, he found that since 1872 they had examined over 10,000 samples of food; out of those 10,000 they had had occasion to bring a certificate into court over 1000 times, and in every case, except one, that certificate had been supported. That was a practical answer to one of the speakers yesterday, who, having announced himself as an analyst to a Defence Association, stated that it was all very well to quote the published reports of the Local Government Board, that those were only the reports of the analysts; but if they were taken into court before an independent tribunal, as he had said, out of twenty cases in which he had advised a defence, nineteen were successfully defended. Unfortunately, the exception in that case only proved the rule, but he would defer dealing with that point until afterwards, when he would show why those nineteen had failed. It was not long ago since he happened to be speaking to a very eminent foreign man of science, who told him he was astonished, seeing how many public analysts there were in England, how they went on year after year making so few mistakes,

No one was infallible, all make mistakes; but the mistakes made by public analysts were wonderfully few considering the enormous number of samples which passed through their hands. With regard to the Act of the present time, he found that in 1872, taking two of his districts, Lambeth and Wandsworth, in Wandsworth they prosecuted 25 per cent. of cases showing a large amount of adulteration, for he did not mean only adulteration on the analysts' report, but adulteration proved to exist by convictions. In Lambeth also there was the same proportion; last year the percentage in Wandsworth had come down to 6½, and in Lambeth to 12. This was a direct proof of the benefit of the Act.

In Wandsworth especially, the Act was carried out in a most intelligent and excellent manner. One man was set apart whose whole duty was to perambulate the parish, and try to get hold of bad articles, but he could only find 6 per cent. But ought they to be satisfied with the Act as it now stood? He thought not; there was no reason why what was done in one parish should not be done in another. Still, limiting himself to his own experience, he found that in one district, where the inspection was very complete, and the number of samples taken annually was never less than 400, the percentage of adulteration had been reduced from 25 to 6½; in the next district, where the inspection was not quite so complete, where only 300 samples were taken, it had only been reduced from 25 to 12; and going again to another district, where the inspection was very incomplete, and where probably he did not get more than 20 or 30 samples in the year, he found every one of them bad. Then he came at last to two districts, one of them, that of Newington, where the Act had never been put in force at all. What the state of matters was there he had no means of saying, as it was not his business to go and collect samples; but he thought if some of the newspaper editors would undertake to make an examination of those districts, rather an astonishing revelation would be made. What, then, were the points on which the Act required amendment? In the first place,

there ought to be a compulsory appointment of inspectors. The Local Government Board could make it compulsory on a Local Board to appoint an analyst, but as they were not bound to appoint an inspector, the analyst would have nothing to examine. Inspectors also ought be appointed compulsorily, and it ought to be compulsory that the number of samples purchased for examination in the course of the year should bear some reasonable ratio to the number of dealers within the district. It might be too much to expect, but he certainly thought every dealer ought to be visited at least once a year, so as to see who were honest men and who were not; particular dealers ought not to be singled out, but a regular system ought to be adopted, and one sample, at least, taken from every dealer. If he understood Dr. Bell rightly as far as he expressed an opinion, it was not desirable to have too many limits and standards, but his opinion was that the true reform required was that the Act should be assimilated in many respects to the New Zealand Sale of Food and Drugs Act, and that there should be certain limits fixed, below which articles should be deemed adulterated. This point came very prominently forward in the case of milk, with regard to which Dr. Bell seemed to think that if such a course were adopted it would restrict the out-put. He did not think it would have that result, and it seemed to him that where you had a variable article like milk, the lowest possible honest milk should be the limit below which the dealer should not go, though he might go as much above it as he liked.

It would leave every man perfectly free to take his own view of his own business, and the man who sold the best milk would get the most business. Why should a reasonably low limit restrict the trade at all? In order to arrive at a limit, there should be a permanent Commission appointed, consisting of one eminent chemist appointed by the Government, such as Dr. Bell, another appointed by the Public Analysts, and a third who should represent the Chamber of Trade. It should be the duty of the Commission to examine in turn every commercial article of food,

and to lay down a limit, beneath which that article should not sink, and when that Commission made its report, an Order in Council should be sufficient to give effect to the standard. That would put an end to all heart-burnings, because the traders themselves having a voice in the Commission, as well as scientific men, every one would feel that the matter was fairly dealt with. This was not a chimerical scheme, for it was already adopted in New Zealand, and during last year the schedules of standards had been commenced which would be added to from time to time on the recommendation of the Commission of Experts. With regard to the question of milk generally, he had rather radical views, and he thought the great mistake made by everybody, including analysts was, that they had been too anxious to draw a hard and fast limit, based on one particular quality of milk, when it seemed to him there ought to be a sliding scale. Supposing they adopted the figure of 9 per cent. solids not fat, as the standard, it had been his experience, extending over some 6,000 analyses of milk, that wherever the solids not fat were very low, there was invariably an increase of fat in the milk, and he, from the first, had made it a practice never to condemn the milk where the solids not fat fell to 8·3, or 8·5, if that milk had an excess of cream, because he found that when you lowered the one you gained in the other. Therefore, he thought the standard should be so fixed that if the fat were over a certain limit, it would not matter if the solids not fat were rather lower. On the other hand, if the fat were below a certain limit, plainly showing that skimming had taken place, then the solids not fat ought to be calculated on a higher standard, because taking away the fat from the milk by skimming increased the proportion of solids not fat. He hoped that before many years a Commission would be appointed which would have the power to make these standards, and that a sliding scale in this case would be adopted.

He had been asked by some of his colleagues to refer briefly to some remarks made yesterday. In the first place, Dr. Voelcker, for whom they all had a great esteem, made

rather an unfortunate slip in giving what he called some advice to public analysts, which was not to be too hasty in jumping to conclusions. It was certainly very good advice, and he did not object to any one advising him, but the question arose, Did they require that advice, and was Dr. Voelcker entitled to give it? That gentleman, to show some ground for the advice he gave, mentioned a certain case in which a sample of cream contained starch, which on investigation he ascertained to have arisen from its being strained through a new cloth. But then this difficulty arose: if Dr. Voelcker had been in the position of a public analyst, and the cream had been brought to him by an inspector, he would not know where it came from, and would have no opportunity of making inquiries about the cloth or anything else. He was bound by the law to state either that the cream was pure, or that it had something in it. What was the analyst to do but to state that the cream did contain starch, and leave it to the other party to explain how the starch got there. Then Professor Attfield had spoken to twenty prosecutions, nineteen of which failed, and the inference would naturally be that in those cases adulteration did not exist at all. He would give one or two cases in point to explain the matter. There was a public analyst who had to examine some scammony—rather an expensive drug—in which he found chalk, and it effervesced in hydrochloric acid. The analyst, referring to the notes about scammony in the Pharmacopœia, found it specially mentioned that it ought not to effervesce in hydrochloric acid. At all events, he felt bound to give a certificate that that scammony did contain chalk. Then the case came into court, and the Defence Association and Professor Attfield came forward and explained that that chalk must not be taken notice of at all, it was not an adulteration, and that the scammony-root grew in a chalky soil, that the gum was obtained by making little incisions in the root and by putting in little shells in which it collected, and what was more natural than for the innocent natives to put a little chalk upon it to keep the scammony

from sticking to the shell. Of course the analyst was laughed out of court, and the chalk was pronounced to be not an adulteration but a mere accident. But that did not show the analyst was wrong. He was bound to say exactly what he found there, or else say the article was pure, which in that case he could not. He could not go into an explanation of this story about the niggers and the chalk, which the defendant could and did so successfully. All these nineteen prosecutions were of a similar nature. To take another instance, an analyst had brought to him an article which was called milk of sulphur, and on analysis he found it contained so much sulphur and so much sulphate of lime, and the authorities took the case into court. He should remark here that the analyst had nothing to do with taking the cases into court; he simply said what the article contained, and it was for the authorities to decide whether proceedings should be taken. When this case came into court, the other side came forward and showed that it was quite a common thing to put sulphate of lime with sulphur; that in fact the public liked sulphur mixed with sulphate of lime, and that for some complaints it was far better, and in point of fact it was quite a legal thing to sell. He was not going to dispute the decision that it was legal, but it was not anything against the analyst, whose report was not in any way impugned. Both in that case and in the case of the scammony the decision did not affect the analyst. It was a mere settlement of the legal question, whether scammony should naturally contain chalk, and whether sulphur should naturally contain sulphate of lime. It was settled that they should, and those were things that had to be brought before the Court to settle, for there was no other way of settling them. Another case was referred to by Dr. Voelcker, in which milk threw up a purple cream, and on examination he found it contained aniline. Of course, not being a public analyst, he did not jump to a conclusion, but made inquiries, and found the milk had been filtered through a red cloth. He assumed that, had he been a public analyst, he would have jumped to a conclusion.

What else could he have done? He could not have said the cream was pure, and must have stated that it contained aniline. It was not his province to inquire how the aniline got there. After this explanation he hoped that the position of public analysts would be more fairly understood in future.

The following communication was then read by the Secretary from Mr. Bannister, of the Chemical Department, Somerset House, who was unable to be present :—

Dr. Dupré, and other public analysts who spoke yesterday, attempted to draw a great distinction between the standard or limit of the public analysts, viz., 9·0 for solids not fat, and 2·5 of fat, and that of Somerset House. In this statement the fact is altogether overlooked, that the methods of analysis are different, and therefore the results are not concordant. The method of obtaining the amount of solids not fat laid down by the public analysts is to dry the solids not fat for three hours only, and not continue to dry till the weight is constant. In our laboratory the "solids not fat" and "fat" also are dried till the weight is constant, and from experience we know that 9·0 per cent. of solids not fat, as determined by the method followed by the public analysts, is only equal to about 8·5 per cent. when dried to a constant weight. Many of the analysts are alive to the unsatisfactory results obtained by the Society's method, and Mr. Hehner, who spoke yesterday, says of it ('The Analyst,' vol. vii. No. 73, April, 1882) :—

"It appears to me that as much more concordant results are obtained when the solids are dried to constant weight than for three hours only, it would be well to discard the old plan, and accordingly to lower the limits of 'solids not fat' from 9·0 to 8·5 per cent."

It is therefore not a matter of difference of standards, but of the methods of working, and it is unfair to try to lead the public to believe that we have lowered the standard for milk simply, because we work in a way which gives constant results. We gave the three hours' drying method

a fair trial, but as it was not reliable we abandoned it many years ago for the one we now employ.

With regard to the admission that milk varies in composition, it is pleasant to know that this fact is now conceded, for I remember very well when many analysts held that milk did not vary in composition, but only in the quantity given by different cows, and that it was childish to suppose that any cow could give milk containing less than 9 per cent. of solids not fat.

In construing the Food and Drugs Act, we must bear in mind what was the deliberate intention of the Legislature in placing it on the Statute Book, and this intention is well expressed in the report of the Select Committee of 1874 in the following words :—

"Too high and rigid a standard has been fixed by some analysts, and no sufficient allowances have been made for natural variations in milk. Ten per cent. of milk solids may be more difficult to obtain under certain unfavourable conditions than 12 or 14 per cent. under a more generous diet, a warmer atmosphere, and a comfortable lodging. . . . Allowances should therefore be made for these natural variations, which some purely scientific chemists seem to have occasionally overlooked."

It is evident from this quotation that the Legislature could not agree with the views of the analysts, and it is equally evident to me that if more stringent regulations are to be enforced, we must get further powers in a new Adulteration Act.

The following communication was then read from Dr. Wallace, of Glasgow :—

With regard to the question of the possibility of having a standard for milk, I think it would do very well to have a standard not too low, say, 8·5 solids not fat, and 2·5 of fat, or 8·75 and 2·75 respectively, and that in any case when the quantities came below these standards, the milkman should have the privilege of proving his innocence by

having the cow or cows milked in presence of the inspector or the analyst. In the case of a man having, say, a dozen cows, it should be no defence for him to show that one of his cows gives milk of unusually low quality.

In any future Act it should be made compulsory for all towns and local authorities to appoint both analysts and inspectors, and the analyst should be paid not by fees, but by a fixed salary, at the rate of *not less* than £1 for every 1000 inhabitants; and the inspector should be obliged to supply to the analyst *not fewer* than one sample per annum for every 500 inhabitants.

There should also be a provision for employing, under the instructions of the inspector, working people, in their everyday apparel, to take samples, as it is useless to attempt to get correct samples by employing ordinary inspectors, who are frequently police sergeants, and who, at all events, are well known to the dairymen and shopkeepers.

Mr. GEO. BARHAM said they had been all much instructed by Dr. Bell's able Paper; a discussion on the adulteration of food was very important, and it was pleasant to see so many public analysts taking part in it, but he must express his regret to see so few of the other side present. What was wanted at such Conferences was not to hear one man's ideas, or one set of men's theories, but to endeavour as far as possible to insure the supply of pure food to the public. Instead of public analysts setting themselves apart from traders, and looking upon them as their natural enemies, and speaking in a sneering tone of commercial morality, he thought it would be better if they occasionally called in the leaders of the various trades to aid them in carrying these Acts into operation. Having given evidence in the year 1884 before a Committee of the House of Commons, which inquired into the working of the adulteration Act of 1872, and representing 300 dairy farmers, and being deputed by the Metropolitan Dairymen's Society to be present at this meeting, he thought he was entitled to say a few words. He had the greatest respect for public analysts, but as there were dairymen and dairymen, so there were public analysts and public analysts, and those gentlemen who were members

of the society knew very much better where to draw the distinction than he did. Professor de Chaumont had spoken on the previous day about commercial morality, and said they could never stop adulteration until the scale of morality was higher, and that was no doubt correct. Why should a dairyman be asked to supply milk without water, when he had to buy beer with 50 per cent. of water, to buy bread with a certain proportion of alum ; as to drugs, he was not quite sure about them, and even taking professional men, like lawyers, did they not skim their milk ; did they not set it for years and skim it every two or three months, or as often as they could get a cheque. If he went to a horse repository to buy a horse, did he find honesty there? and it was said that cattle jobbers were even worse than horse dealers. If he bought a piece of furniture he was assured that it was solid mahogany when it was only veneered ; or if he went into a linendraper's to buy flannel or cloth, and purchased what was warranted to be all wool, it would probably be found to contain more or less cotton. What protection had he in all these cases ; and why should dairymen, therefore, be expected to be the only honest people in the world. Of course they ought all to be honest, but they ought not to be attacked as if there were none honest among them. Dr. Voelcker had spoken of cream being extracted in the strawberry season, but he should like him to be apprenticed to the trade for a few weeks, and he was quite sure he would be satisfied that in such a season it was quite impossible to take off the cream and sell the remainder after standing for twelve or twenty-four hours as fresh milk. With regard to the use of boracic acid and bi-sulphite of lime, and so on, in his opinion they should be forbidden. As one of the public, he had no right to have his children dosed with boracic acid day after day for the purpose of enabling the dealer to save his milk ; and if he bought beer he did not want bi-sulphite of lime. All such preparations should be forbidden ; no doubt it would entail a certain amount of waste, but the public must pay for it, and they had better do that and have the article pure. He had no desire to be personal, but if he were inclined

to be so, he should take exception to a public analyst occupying a very high position, writing sensational articles in the paper with reference to milk which had been purchased by his own officials, and then writing a letter to be advertised in the public prints, to one dairy firm two or three days afterwards, saying that the milk supplied by the said firm was perfectly pure. He thought that was highly objectionable, and he wondered that the Society of Public Analysts had not a certain amount of *esprit de corps* and professional pride which should prevent such things being done. Dr. Dupré spoke with reference to the adulteration of milk, and the quality he found on Sunday mornings and other days, but it seemed to him that he had named his own remedy, he had only to send every other Sunday for samples, and the milk would always be pure. Then Mr. Hehner said the Adulteration Act had worked great benefit, for whereas milk used to be adulterated with 50 per cent. of water, they now rarely found 20 per cent., and in the majority of cases it was only 10 per cent. He was pleased to hear it, and he believed it was perfectly true; but what did Mr. Wigner say? that within the last four or five years the percentage had increased, and if that were the case the only inference to be drawn was, that the analysts and inspectors and all this great expense was of no earthly use. Another gentleman referred to the Paris supply, and he had often noticed that Englishmen disparaged themselves more than any one else, and always thought that things were done very much better abroad. For instance, he once heard the secretary of the Royal Agricultural Society say he would not drink a drop of English milk, and would not allow a pound of English butter to come into his house—a most extraordinary statement for such a man to make—because he found everything was done so much better abroad. Why was that? It was simply because he had gone abroad as secretary of the Royal Agricultural Society; he had been taken to show places, and everything had been made nice and smooth for him, the same as we should do here if the secretary of some great society abroad should come, sending a letter beforehand to say when he

was to be expected. He had made the supply of milk to Paris a particular study, and had seen the whole process from beginning to end. In the first place, the morning milk was boiled, it was cooked milk, the night's milk was put with it, a thing unheard of amongst dairymen in England, and those two milks mixed together were sent in to Paris next morning. They only had a supply once a day, and on a hot summer's day it was impossible to get a drop of sweet milk at one o'clock in Paris. He had tried to do so, saying it was wanted for a sick child, but he could not get it; he was told they had a little milk just on the turn, which would be all right with a teaspoonful of bicarbonate of soda stirred up with it, but that was the best he could obtain. There was no town in the world supplied with better milk than London. He must say he was very much pleased with Dr. Muter's careful speech; he said he would have no water put into milk, and there he agreed with him; but this was his difficult point, which he could not reconcile his commercial morality to: the analyst went into Court and swore that a given sample contained added water. Now, had he found the added water? No, he knew he had not; he had found a certain amount of solids, and if he were to go into Court and say that he had only found a certain amount of solids, and inferred that there must be added water, the case would be dismissed. He acted entirely by the amount of fat, and no fatty solids, and he went deliberately and told the magistrate and signed the certificate that he found a certain amount of added water, and in the result the dairyman was convicted of fraud. It was said that eels got used to being skinned, and some people seemed to think that dairymen paid the fines with a great amount of pleasure. But there were dairymen who would scorn to be convicted of fraudulently deceiving the public. Professor de Chaumont, speaking of commercial morality, said these men would scorn to put their hands into his pocket and take out *6d.*, but they would not hesitate to defraud him by adulterating his goods, which in reality was the same thing. You were convicting that man of picking another man's pocket—in fact, of robbery,

for there was no other term for it. As to paying the fine, it was comparatively nothing. As Shakespeare said :—

> "Who steals my purse steals trash ;
> But he that filches from me my good name,
> Robs me of that which not enriches him,
> And makes me poor indeed."

And many traders were under the same impression. When this Act was first passed, the Society he represented invited the public analysts to meet them with the view of fixing standards, but that was declined. What they wanted analysts to do was to give them a ready means of detecting added water. He did not mean water digested by the cow, but raw water added, and if they could do that he would guarantee it would do more to stop adulteration than all the fines in the world. With regard to the standard, a cow had been called a machine for making milk, and so she was, but unfortunately they could not control her like a steam engine, and though you gave a cow good food, she might take it into her head to produce a large amount of fatty solids, and a small proportion of non-fatty solids, and if they sold that to the public they might be convicted of selling watered milk. 9 per cent. was adopted as the standard for non-fatty solids, and at that point the public analysts did not give a certificate that the milk was adulterated, but if it should only come up to 8·5, 8·6, or 8·7, did they say that the difference between 8·7 and 9 represented the amount of adulteration? No! They raised the standard then to 9·3. Was that just and right? Were they not deceiving the magistrates, the public, and everybody else, if it were so? Now, with regard to this standard, he would quote a few figures. There was a dairy show held annually in London, and one of the most useful classes was the class for milking cows, in which the prize was given for the animal which gave the most milk of the richest quality. It was the duty of every exhibitor to feed his cows as well as he could, and to get the very highest quality of milk. The figures he was going to read would be found in the report of the British Dairy Farmers' Association, the samples being taken in the

presence of four or five judges, and analysed by Dr. Voelcker. The following were the figures of the milk of some of the short-horn cows :—

Non-fatty solids	..	8·5	Fatty	..	4·1
„ „	..	8·8	„	..	3·7
„ „	..	8·4	„	..	4
„ „	..	8·8	„	..	4·7
„ „	..	8·8	„	..	3·1
„ „	..	7·8	„	..	3·9

Was it to be said that these animals were to be sent to the butcher as being unfit to produce milk? Out of 23 short-horn cows 12 gave less than 9 per cent. of solids not fat, the average being 8·9, and 3·7 of fat. Taking Jerseys and Guernseys, which gave the richest milk in the world, one gave 8·8, another 8·5, and another 8. Again, taking the Dutch cows, the average of total solids was 11·8, the fat being nearly 3, so that the average of the whole of the cows was less than 9. Were all these animals to be sent to the slaughterhouse? He could tell them how they could be sure of having pure milk, and that was to make up their minds never to pay less than 5*d.* a quart for it; dairymen would then get a fair profit, would be afraid to lose their custom, and would always supply pure milk. If they were working like brewers and did as Dr. Richardson said they ought to, for he contended that drawing milk from a cow was a barbarism, that the component parts ought to be mixed together without the trouble of going to the cow for it, and when they could prepare milk like that, then would be the time to fix a standard. You could not go to a butcher's shop and always find the meat containing the same quantity of fatty and non-fatty solids. If a standard were fixed, it must be low enough to cover the poorer samples, and then people would have to depend on the repute of the firm with which they traded. With regard to the butter-fats, that was a most difficult thing. There ought to be 3 per cent., but if that was always insisted upon, any dairyman might be fined or punished. An alteration was constantly going on in milk; if it were

set in a can at night, by the next morning the cream would be at the top, and the heavier portion at the bottom, and that change went on not only in the dairyman's shop, but in the cow's udder. Some Sunday morning, when the inspector went to get samples, the dairyman's man might have overslept himself, and instead of finishing milking the cows would scamp them, the consequence of which would be that there might be only 2 per cent. of fat in the milk. Then, again, milk which came 150 miles, as some of it did, might be partially churned; he had seen globules of fat floating on the surface, which would take off ½ of 1 per cent. of the fat. Then, again, the milk stood in the cans in the shop, and samples taken later in the day would not be so good as those taken earlier. With regard to altering the Act, he should certainly like to see it altered. Dairymen were not an influential body of men, but some two or three years ago they did go to Parliament and got the Act altered to a slight extent; there was a little Act brought in, saying that milk should be sampled at the railway stations, because unless the sources of any article were kept pure it was impossible to have it distributed pure, and in some cases it was alleged that the milk was sent up from the country in an adulterated state. The Act was therefore altered, giving power to the inspectors to obtain samples at the railway stations, but perhaps some gentlemen present could tell him at how many stations this was carried out.

Dr. MUTER said it was carried out in Lambeth and Wandsworth.

Mr. BARHAM said it was carried out in St. Pancras and Paddington and the districts named by Dr. Muter, but he believed in no others in London, although the proper authorities had been asked to do so. Then, again, Clause 14 said, the inspector, when purchasing a sample should offer to divide it into three parts. Now those words, "shall offer," ought to be taken out, and it should be compulsory on the inspector to divide the sample. Another point was with regard to the written warranties; these traders were

told they should buy their goods with a written warranty; they were probably aware that a dairyman purchased his milk twice a day, and if he agreed with a farmer or a wholesale man to supply him with milk warranted pure for a twelvemonth at a given price, they would suppose that was a written warranty, but it was nothing of the kind. It had been decided that a dairyman must have a written warranty with every consignment, which of course was utterly impracticable. What farmer would get up at four o'clock in the morning to write a warranty to put on a can of milk? Then, again, the Act provided that in the certificate the analyst should say if the milk had undergone any change. He thought it would be better to provide that the summons should be issued within a week which would allow plenty of time for the analysis to be made, and if necessary the remainder of the sample could be tested while it was comparatively fresh. If the Act were to be carried out properly it should be made to people's interest to carry it out. There was more heartburning over one honest man convicted unjustly, and more prejudice excited against the Adulteration Act, than by 500 just convictions.

Dr. STEVENSON said he had no intention of replying to Mr. Barham, who represented a large and important interest, but he could not help feeling that if they could get at his own private opinion he would be inclined to fix a higher standard for milk than he had admitted in his speech. He was unwilling to fix any absolute standard, and was rather inclined to agree with Dr. Muter, that when milk was rich in cream, or butter-fat, some allowance might be made for solids not fat. At the same time, he must enter a protest against the adoption of any such standard as had been proposed by Dr. Voelcker. He was quite sure that although the milk supply in London was greatly improved, it was not what it should be, and if that standard were adopted they would have a depreciation of the quality of milk very likely to the extent of 10 or 12 per cent. Mr. Barham said that analysts swore that milk contained so much added water, but though he had signed some thousands of certificates under the Act, he was not aware that he had

made any such declaration. The form of certificate was that the analyst expressed an *opinion* that there was so much added water. He wished to impress on the general public, a good many of whom he believed were present, that public analysts were desirous of having more assistance from them in carrying out the Act. It was quite astonishing the few samples which were sent to them in this way. In the case of public institutions especially, he had had from time to time to examine the drugs supplied to hospitals, infirmaries, and so on, and he had been astonished to find what inferior articles, as a rule, were supplied, compared with those supplied to the general public. It was, of course, said that the manufacturers contracted at a figure for which the articles could not be supplied, and possibly that was so in many instances; but still that did not exonerate the trader from promising to supply a genuine article at a price at which he knew it could not be legitimately sold, and then supplying an inferior article. It would be well if analysts directed their attention more to drugs, and he mentioned this because he noticed there were many gentlemen present connected with pharmacy. He had examined many articles supplied by pharmacists, and he could vouch for many of them, that they were supplied with a care and precision of quality which left nothing whatever to be desired; but, on the other hand, there were certain classes of traders supplying at a cheap rate to medical men and public institutions drugs of a very inferior class. To give an instance recently brought before him, though not officially, in a compound senna mixture he found that its virtues depended on the presence of an enormous excess of Epsom salts, which was a legitimate constituent; but the senna was conspicuous by its absence, and the very much cheaper sulphate of magnesia was substituted. He did not mean to speak disparagingly of pharmacists as a body, for he thought no class of the community, as a rule, supplied better articles, but there were many who did not. With regard to the question of articles of an inferior character being sophisticated by the addition of something which

gave them a good appearance, such as the addition of alum to bread, he should have liked that point to have been discussed by those best competent to form an opinion how far it was legitimate to utilise inferior articles in this way. It was well known that there were certain classes of flours which were not what was called in a sound state, and out of which a good presentable loaf could not be made, yet by the addition of alum it could. He was of opinion that if you took an unsound flour and added alum to it, and made a presentable loaf, the purchaser had a more wholesome article than if no alum were added to the unsound flour; but that did not quite settle the question. If the purchaser were told that alum was mixed with the bread, it would be right enough, but he did not understand the morality of giving to this originally inferior article a better appearance, and making it more like a good article; and this was only typical of several other things that were treated in the same way.

Mr. EASTON (who described himself as a dairyman and editor of a paper connected with the dairy trade) said dairymen had no antipathy whatever against analysts as individuals, but they had an antipathy to incapable analysts who were not quite fit for the position they occupied, and whose certificates had been the means of partially ruining many honest traders. The statement had been made, that out of a thousand cases taken into court, only one had been lost, but the question was how many of them had been contested. There were hundreds of cases where the defendants did not attempt any opposition. He knew a case where a man was fined for the addition of 4 per cent. of water, and he got the case adjourned, and sent the sample to Somerset House, and he was happy to say they gave a righteous decision, and the case was dismissed. One gentleman, who spoke yesterday, intimated that public analysts were better fitted to give an opinion than the chemists at Somerset House, because they analyse every year 6000 samples, whilst at Somerset House they did not perhaps analyse more than 600 altogether. But had the Public Analysts any evidence of the identity of the samples which they

analysed, and if not how could they pronounce any of them adulterated. Did they obtain samples produced under all the different circumstances? or had they obtained them indiscriminately, and formed a general average? According to one gentleman, the adulteration of milk had dropped from 50 per cent. to 6 per cent., and the adulteration of articles of food had been going on from time immemorial. Now, as the Adulteration Act had only been in existence since 1872, it was quite within the range of possibility adulteration might become extinct, and then the occupation of the Public Analyst would be gone.

Mr. HELM (Somerset House) said Dr. Bell's paper was so cordially received that it was scarcely necessary for any one from the department over which he presided to address the meeting, were it not that in the course of the speeches a serious charge was made against him and his colleagues in their capacity of referees. Two gentlemen of position amongst public analysts had made the very serious charge that in adopting the standard they had at Somerset House they had taken as their standard either diseased or improperly fed cows. Now they could have no motive for doing so, and they had done nothing of the kind. They sought London round, and went as far north as Derbyshire, and as far west as Somerset, in order to get fair representative samples. Those two gentlemen said that the limits adopted by the Society of Public Analysts were 9 per cent. of solids not fat, and 2·5 per cent. of fat, but to-day he had been pleased to hear a past President of the Society say that he himself would pass a milk with 8 per cent. of solids not fat, provided the fat was fairly high; and yet because Somerset House adopted something like 8·5 or 8·4, they were told that their cows were diseased or badly fed. As Mr. Barham had said, it was not usual to exhibit badly fed or diseased cows at dairy shows. Dr. Dupré had on many occasions opposed the referees at Somerset House on account of their not adopting the limits laid down by the Society of Public Analysts, and said they were encouraging adulteration of milk by taking poorly fed and diseased cows as the standard; yesterday he was rather more moderate, for

he said that occasionally a single cow might give less than 9 per cent., though whether such cows were diseased or improperly fed he was not prepared to say, but the mixed milk of a dairy was never so low. Now he happened to have with him the analyses referred to by Mr. Barham of the milk given by the cows exhibited at Islington. Those analyses were not made at Somerset House, but by a man of probably greater experience on this matter than any one in the country, namely, Dr. Voelcker, who found that in five years, from 1879 to 1883, out of twenty-three shorthorn cows thirteen gave a milk below the Society's standard; whilst out of nineteen Jerseys three gave milk below the standard; and out of sixteen Guernseys four gave milk below the standard; and out of six Dutch four were below the standard. Then it was said that the milk from a whole dairy would never give milk below the standard; but if the milk from the whole of the shorthorns exhibited had been mixed and tested, it would have been pronounced adulterated according to their standard. At Somerset House they sent round the whole of the country, and out of 238 single cows the milk of 184 would have been pronounced adulterated according to the Society's standard, being below nine. And out of twenty-four dairies eleven fell below the standard. What were they to think of Dr. Muter, who had passed a sample at 8 if the fat was high; and Dr. Stevenson congratulated him, and said he followed a somewhat similar course, while at the same time the referees, who did not belong to the Society, were to be opposed, because they had thought proper to act upon the results of their own investigation. There was nothing in Dr. Bell's paper which could give any offence to public analysts, but Dr. Dupré said how glad he was to have an opportunity of stating their grievances, one of which was, of course, that Somerset House had been the means of upsetting many of their certificates by not adopting their standard. He could assure him that the chemists at Somerset House were equally glad to have that opportunity of explaining their position, but the letter which had been read from Mr. Bannister had forestalled a great deal of

what he had intended to say, The Society of Public Analysts adopted their standard on a basis suggested by Mr. Wanklyn, one point of which was to dry the milk for three hours only, then to take the fat out of it, and the difference was put to non-fatty solids. Now, of course, if any water were left in the milk, it would go to swell the non-fatty solids; and in a paper which had been read by Mr. Hehner, he had shown that, by weighing the non-fatty solids dried, 8·5 was equivalent to something like 9, as usually estimated. How then could it be said that the cows must have been diseased or badly fed from which the Somerset House referees drew their figures, if 8·5 fully dried was equal to 9? And, as Dr. Bell had pointed out, it was far better in chemical analysis not to have any partial and comparative results, but to deal only with actual results, which any other chemist could deal with. He could assure all analysts present that there was no work done at Somerset House which gave so much anxiety as the reference samples, and they were always glad when their results agreed with those of the Public Analysts. The great question was what could be done to make the Act more effective. Unfortunately it was very inefficiently worked throughout the country. Theoretically the machinery provided was effective, but it was not carried out. Dr. Dupré had suggested that inspectors should be compulsorily appointed, and that a certain percentage of samples should be purchased; and that no doubt would be very good. But what would be the use of appointing an inspector, and insisting on his making purchases, if he always went about in a policeman's uniform. He thought the Local Government Board should be empowered, where there was reason to think the Act was not properly carried out, to work it themselves in some way or other, which he would leave to others to devise, but he feared the Act never would be efficiently worked without some further pressure from head quarters.

Mr. ANGELL said this was the first opportunity the public analysts had had of speaking at such a meeting

before men eminent in the chemical world, and before the representatives of what he might call the Upper House who were set over them. One of the earliest grievances of the public analysts was that they had certain gentlemen set over them in an upper chamber whom they could not approach. He was also glad to have come face to face with those who seemed to look upon public analysts as if they had something like the other side to play. One gentleman spoke of it as if it was a game with two sides, and seemed to think that two blacks made a white, by showing that many other people besides dairymen were to blame. He also seemed to have misunderstood some of the previous remarks, and to have mixed up a statement made by one gentleman, that the percentage of cases of milk adulteration had increased, with the statement of another, that the percentage of water had decreased. The two facts were, however, by no means inconsistent. He also said they could not tell added water from other water, and that was the same complaint he had heard made once before when lecturing before a body of farmers in Hampshire. He had taken some pains to show why it was reasonable to suppose that such a secretion as milk might be expected to be somewhat constant in its nature, and to show by experiments that that was really the case, as it was within certain limits. One of the farmers present then wanted to know whether he could tell added water from other water, and having admitted that he could not, he was told that he was no use, and he might sit down. He did not, of course, accuse Somerset House of having specially prepared cows, though one of the gentlemen seemed to intimate that they were, and if it were the case it might give rise to some difference in the results.

Mr. EASTON said what he meant to say was that at Somerset House they investigated the variations which occur in genuine milk under all circumstances.

Mr. ANGELL said one speaker had referred to the difficulty of deciding as to what might be passed as beer, and it frequently happened that the authorities in various

districts took upon themselves, in a fit of indignation as to the quality of the beer in their neighbourhood, to send him a great many samples, and in consequence of the fact that there was no formula laid down for the composition of that beverage, he was bound, unless he found something absolutely injurious to health, to certify that the beer was genuine, which no doubt sometimes produced considerable astonishment. He thought he could see a way out of the difficulty. If the only alternative was to suppress that very large and very reasonable form of commerce which consisted in making up various kinds of tonic drinks and selling them under the name of beer, or to leave them alone, he should say leave them alone; but he thought it might very reasonably be laid down, that if a man asked for a glass of beer he should have nothing but malt and hops, but in order to meet the difficulty of not suppressing a good wholesome article—not beer—it should be sold as ale. He would suggest that under the name of ale anything might be sold in the shape of bitter and wholesome beverage made from what source it might, but if a man asked for beer he should have malt and hops only supplied. As Professor Attfield was not present, he should not say as much in reply to him as he had intended, but he certainly thought such statements as he had made should be put forward with extreme caution, and he claimed for public analysts a much more independent position than Professor Attfield held with regard to any prosecutions he had been connected with. He had spoken of some 20 cases, and in two or three of these he appeared on one side and Professor Attfield on the other. Now, which of the two were to be considered the more interested parties, the gentleman who held a high reputation as a distinctly qualified man, the representative of a powerful trade union, which came down with its counsel and its legal pleaders, and chemical pleader in some cases, with a vast number of pharmacopœias piled up (and if one did not cover the case another did), or the public analyst? If the analyst ventured to say that the article was set down in the British Pharmacopœia and that it did not answer the

tests there prescribed, then they did not believe in the pharmacopœia at all; but if, on the other hand, there was some other pharmacopœia which could be taken out from the British Museum which would answer their purpose, it was brought out and paraded, and if the case was dismissed, they were told they must look upon it as if an error had been detected. Of course there were such things as differences of opinion, but it was decidedly incorrect to speak of these cases in which prosecutions had been dismissed as if they arose from errors of the analyst. He had intended to have referred to several instances in which Professor Attfield was concerned, in one of which he actually found, where others could not, a very fine trace of soda carbonate in the presence of a considerable quantity of sulphate of lime in so-called soda water, by some extraordinary method which he had kept secret up to the present time, but as he was not present he would not go into details.

Professor REDWOOD said he had listened with considerable interest to the discussion which had taken place, but what had been said by several previous speakers had superseded the necessity of his saying much upon the subject. He almost entirely agreed with what had been said by Dr. Muter, and he might say also with reference to the very spirited remarks of Mr. Barham, that all who heard him must congratulate themselves on having heard a very able defence of the dairymen. But there were two points which had not been thoroughly disposed of, upon which he would make a few remarks. First, in reference to the statement made yesterday, that the Adulteration Act had not accomplished all that was expected from it, or even much that could be satisfactorily referred to, because it was found on reference to statistics that the proportion of adulterated articles continued very much what it was in the first instance. No doubt that argument would have weight with many persons unless some explanation were given of it. Now it appeared to him that that arose mainly from the circumstance that a very considerable change had taken

place in the nature of the substances collected by the inspectors for analysis as compared with what was the case some years ago. He had been a public analyst almost from the commencement, and had had very considerable experience, and he should say that when this work commenced the inspectors were in the habit of collecting a very large number of samples of different kinds, but in process of time it was ascertained that a large number of these articles which they had been in the habit of collecting were found practically never to be adulterated, and latterly the inspectors had confined themselves to a limited number of articles, such as were most liable to adulteration—such, for instance, as milk, butter, coffee, mustard, and a few other articles—those, in fact, referred to by Dr. Bell as being the articles which were alone found to be to any general extent subject to adulteration. Seeing that the articles now collected were only those liable to adulteration, it would naturally follow that the proportion of adulterated specimens amongst them should be greater in relation to the aggregate than where a larger number of different classes of articles were examined. This was the principal cause of the continuance of the same percentage of adulteration as occurred some years ago. There were other causes certainly, amongst which might be named the imperfect manner in which the Act was carried out, for in those districts where it had been most regularly and systematically enforced, there had been a very considerable improvement. In one of the two Metropolitan districts with which he was connected, there had been a very large improvement in this respect; whereas in others the case was quite otherwise, those being districts where the inspectors only now and then purchased samples for analysis; the result of which was that certain traders got into the irregular habit of supplying adulterated articles. He should be glad to hear from Dr. Bell whether, when he referred to cocoa and mustard, he intended to indicate that he did not consider the addition of flour, starch, or sugar an adulteration. The view which he acted upon was this: he certainly considered

the substance sold to the public under the name of cocoa was well understood, unless there were some special explanations given, to be cocoa mixed with starch and sugar, but, nevertheless, if he found a sample with an undue proportion of those additions, he should look upon it as an adulteration. The same with reference to mustard; from the commencement he had considered that the addition of a little flour to mustard improved its quality, where it was used for dietetic purposes, but if he found more than 8 or 10 per cent. of starch, he should certainly also look upon that as an adulteration. Of course, if mustard were intended to be used for medical purposes, it should be in a state of purity; but when only used for dietetic purposes, he did not consider that in those cases in which the starch was intentionally omitted it was really any better in quality than it would be if there were a certain portion of starch present in it.

Mr. CHESHIRE said he was very glad that he had taken the trouble to come from Hastings to attend the Conference which had been very interesting. It was stated that the percentage of adulteration was probably very much higher than the reports gave, on account of tradesmen often knowing the inspectors, especially when they were in uniform; but he would draw attention to the fact that there was another side to that question, in his district certainly. There the inspector only procured samples when he had reason to suppose he should find them adulterated, and yet they found that only about 15 per cent. were adulterated. Means were taken by the inspector to prevent suspected persons knowing him, by sending other persons, or by asking for articles from special canisters, and he might say that in the case of about half-a-dozen samples which had been sent to him for analysis by private persons he had not found one adulterated. One reason why small fines were sometimes imposed was, that they did not always fall on the really guilty party; the small dealer often bought from the wholesale man without a written warranty, in which case he had to suffer, and the plea was often made, in the Hastings

Court, that they had sold the articles as they bought them. With regard to the amount of adulteration, he had always made it a practice only to certify to such an amount as he could feel sure of, but if a very small amount only were stated, so as to be quite safe, sometimes the magistrate would remark upon it to the effect that there must be some mistake, for it could not be worth the while of the tradesman to run the risk of detection for such a small advantage. With regard to the necessity of giving quantities in the certificate, he was in favour of keeping things as they were. He thought an analyst ought to be bound to say something about quantity, for though it had been very fairly remarked that it was very difficult in some cases to give the quantity at all accurately, he for one always put the word "about" in, which was quite sufficient to cover any slight margin. Only recently he had a case in which he had certified that a sample of raspberry jam contained about 50 per cent. of apple jam ; he believed it was really more, but that word "about" was never objected to. With regard to the improvement in the percentage, he might refer to another district, Rye, which was one of those places in which they went for three or four years without taking any samples, and then made a grand rush. He would have a letter from the Town Clerk, stating that some samples were going to be brought to him, and shortly he would have a number of samples of milk, one from each dealer, nearly half of which turned out to be adulterated. The Town Clerk also said that next week he was going to send him samples of butter, but he told him afterwards that he could hardly find any butter in Rye, that it was all butterine. That showed how much more careful tradesmen were when they knew the Act was going to be put into force. The Chairman had referred to the question of beer, and said there seemed to be no definition of it. Now, he took it, it must be a fermented liquor containing spirit and a wholesome bitter, and that was the definition he had gone by. As regards the use of chemical re-agents, he adopted the practice that if they had been used reason-

ably, and with good effect, he passed them, but he thought there ought to be some precise understanding about these things. If a chemical re-agent looked at all suspicious, and was in any way unhealthy, he should certify against it at once. With regard to milk, it appeared that a majority of the low standard milks were analysed by Dr. Voelcker, and he thought it was quite clear that he adopted some different plan for drying the solids to that generally followed. In his own case, he adopted the usual plan of drying for three hours, and in every case—except where the fats were high, when if the solids were a little low, it had been passed—if it fell below 9 he had certified against it, and he never had an appeal to Somerset House, which appeared to show that the milkmen, in those cases, admitted the adulteration. As regards any alteration in the Act, it was quite true the word "adulteration" was not mentioned, but in their reports they had to state that a certain number of samples were genuine, and a certain number adulterated. With regard to that, a question had been raised whether skimmed milk could be said to be adulterated, and he thought perhaps "sophisticated" would be a better word. He had intended to have made some remarks on what fell from Professor Attfield, but after what had been already said, it was not necessary.

Mr. LLOYD said he thought the great object of the Food and Drugs Act was to ensure health, and that the public analyst was required rather to protect the public from any ill-effects of their food than to ensure that it should come up to certain standards. That was the difficulty he found in coming to any conclusion as to standards, especially in regard to milk, because that had proved of all articles of food the one which was most likely to produce disease. If the very best milk had water added to it, you enormously increased the liability to disease. There was also, he understood, a large amount of condensed milk mixed with water being sold as milk, and, if there were one practice more than another likely to prove detrimental, that was it. The liability to disease from even minute quantities of water getting into milk had been very great, and there-

fore the danger would be much greater if condensed milk were to be made up to the strength of ordinary milk, and sold as such. If the milk were condensed with sugar, the analyst could detect it, but some condensed milk was made without sugar, and he did not exactly see how that was to be dealt with. It was said the Act was largely a failure, owing to inspectors not being able to obtain samples, but that was provided against by the public being enabled to take samples. The difficulty, however, arose owing to a fee of 10*s.* being required, because no one could be expected to buy a shilling's worth of food and pay 10*s.* in order to prove whether it was pure. It was the duty of the State to protect the public; how that was to be done he was not prepared to say, beyond suggesting that, where there was any suspicion aroused, the public should be invited to apply to the inspector. After all, the great thing was to educate the public more upon this question. You could not expect a poor man to pay 1*s.* 6*d.* for coffee without chicory in preference to paying 1*s.* for coffee with chicory; and until they could educate the public to see the effect of pure food, the Act would never receive that public support which, after all, it mostly needed. He did not think it necessary to extend the Act to agricultural substances. The reason why analysis of food should be made at the expense of the State was because the food cost comparatively little compared to the cost of the analysis. But that was not the case with cattle food, and if you included feeding cakes which the farmer bought in large quantities, and with regard to which he could afford to protect himself, and was assisted by Farmers' Clubs in doing so, he did not see where you could stop. If it held good for cattle food, why should it not hold good for the manure with which he grew his crops, and the principle would have to be extended to analysis of woollen cloth and everything else.

Dr. VEITCH said that almost all the speakers who had addressed the Conference had referred principally to the question of milk adulteration. It was a question deserving of the great attention paid to it, because milk was an article of food not only in daily use, but one on which the younger

part of the population almost entirely depended. He had devoted the last eight years exclusively to analytical work in connection with milk and milk products, and in the laboratory which had been under his charge for the last four years some 50 to 60 samples of milk were analysed daily. That there were some difficulties in connection with milk analysis and milk adulteration he thought was sufficiently proved by the animated debates which ensued whenever the subject was made a matter of discussion. The variations in the natural composition and the alterations caused by the tendency of the fat in milk to separate in the form of cream made it difficult to ensure the supply to the general public of an article in no way tampered with, and at the same time not to do wrong to the honest dealer. The liability to speedy decomposition very often made it difficult to prove a suspected, and confirm an alleged adulteration. Bearing in mind the fact that milk naturally varied to a great extent, a prosecution for adulterated milk would be almost impossible unless some standard or better limit were fixed. The question of how the limit should be fixed was a difficult one, and in his opinion could not be solved satisfactorily as long as the milk of individual cows and dairy milk was treated in the same way. Milk of individual cows sometimes came down very low as far as composition was concerned, and he could see no reason why dealers should not be compelled to sell such a milk labelled accordingly, and a lower standard should be applied to it. Dairy milk, which was the milk of a number of cows mixed, was much more uniform in character, although it might vary a great deal. The special gravity of milk could easily be ascertained by means of a small lactometer, and if only every small milk dealer who had no other means of protecting himself, and every householder who liked to have pure milk for himself and his offspring, would use this instrument, a great deal of watered milk would be banished from the streets of London in the shortest time ; but as it was impossible to detect adulteration in every case by this means, there would still be a great deal of the work left to the analyst. Where to fix the limit was a question of analytical method ;

if the total solids were given, the fat and non-fatty solids compensated one another. If by one method the fat was exhausted to the last trace, the solids not fat would be proportionately low; if, on the other hand, a particular method left about ½ per cent. of fat in the non-fatty solids, the latter would be so much increased. How much of fat and non-fatty solids one might be allowed to expect in milk must be found out by statistical investigation, and he thought there existed plenty of material nowadays to settle the question at once. If out of 100 farmers 99 were able to produce milk of a certain standard, the 100th should be able to do the same, and if he fed his cows so poorly, or watered the milk through the cow, his milk should be excluded from the market. In his opinion, the standard applied by the Society of Public Analysts at present was quite fair and just to both parties. The tendency of the fat to rise in the form of cream must not be lost sight of, and he thought it was only right in the case of milk falling below the fixed limit, it should not be returned as watered or skimmed, but as not of the nature, quality, and substance of the article demanded, and public analysts should not be obliged to make statements which they could not prove, viz., that the addition or depreciation extended to such and such a percentage. As to decisions in the cases of disputed analyses, he thought it utterly impossible to put an analysis of an old and decomposed sample of milk against one made of the milk while it was sweet. As soon as decomposition had proceeded to a certain point, in his opinion, it was almost waste of time to analyse it.

Dr. BELL, in reply, said it was very satisfactory to find that hardly any exception had been taken to the contents of his Paper, and very few criticisms had been passed upon it. Dr. Dupré rather questioned the potency of fusel oil in whisky, but he still adhered to the statement he had made, and thought experience bore him out. It was a very common saying in Scotland, "You will not find a headache in a hogshead of that whisky," the reason being

it was a matured and mellowed whisky, the fusel oil having been entirely changed into harmless compounds. Distillers might entirely dispense with all the trouble and expense of maturing spirits in bond if it were not for the deleterious character of the fusel oil present in new whisky. With regard to the question of cocoa and mustard, put by Dr. Redwood, he had stated, "That the only substances now found in cocoa were sugar and starch, and in mustard flour and turmeric, and these additions are not considered as adulterants so long as the preparations are not sold as pure or unmixed articles." It was not his province to decide what quantity should be present in cocoa or mustard to constitute adulteration; that was for the Justices, but if he found a greater quantity of flour in either article than is usually present in ordinary commercial samples, he should feel it his duty if that question formed part of the reference, to indicate that fact in his certificate. The great bone of contention throughout the discussion had been "milk;" and their position at Somerset House seemed to have been largely misunderstood with respect to that article; and he was glad to have this opportunity of explaining it. In the paper written by Mr. Bannister a paragraph was quoted from the report made by a Parliamentary Committee in 1874, which stated that cows yielded milk of different qualities; and indicating that proper allowances should be made for variations in quality. Parliament was aware of that, and laid down no limits of quality, and fixed no standard, but imposed on the Public Analysts and the Reference Department the duty of saying what was watered and what was not, and this was a serious responsibility in the face of the now admitted fact that milk does vary greatly in composition. Mr. Hehner said that when samples were sent to Somerset House, we often said we could not confirm the analyst's statement that water had been added. That was undoubtedly true, but as a matter of fact the public analyst was exactly in the same position, and the well known principle of English Law was that if there were any doubt in a case, the defendant should have

the benefit of it; therefore, if they could not say that water had been added, although they could not say it had not, they gave the defendant the benefit of the doubt. That, he believed, was the clear intention of Parliament in imposing those important duties upon them. He did not oppose the fixing of standards, or limits, but it was for the public analysts and the trade to arrange as to standards of quality, and not for him to do so; his duty was simply to do justice between two parties. He had no objection to any standard of quality being laid down, provided it was laid down legally, but he could not lay it down, nor could the public analyst. With regard to the variations in the composition of milk, he was pleased to hear Dr. Muter state so honestly and fairly his views on the subject, and he hoped other analysts would follow in the same line, for it was the first time that any public analyst had publicly stated so clearly the truth of the matter. He did not say they were prepared to pronounce milk containing 8·6 or 8·7 of solids not fat not adulterated; if they found evidence sufficient to satisfy their minds from other data connected with the analysis that it was adulterated; but if they had not sufficient evidence from the data obtained, they could not conscientiously pronounce it adulterated, and they gave the defendant the benefit of the doubt. He was not prepared to go down to a very low limit, but was much disposed to agree largely with Dr. Wallace's suggestion, that if the milk went below a certain point, the seller should be called upon for an explanation, and if he could not satisfy the local authorities that his milk was genuine, then he should be called upon to satisfy the Justices. He thought that was the fair and proper way in which the Act should be applied to an article like milk. The desire of all should be to avoid inflicting any injury on honest tradesmen, for, as Mr. Barham had pointed out, it was a most serious thing for a tradesman to be fined for adulterating an article if he were innocent. With regard to the last speaker's remarks on the subject of the analysis of sour milk, it will, in my opinion, suffice for me to say that I entertain entirely

different views on the matter. In conclusion, he begged to propose a vote of thanks to the Chairman for the very able and fair way in which he had conducted the Conference.

Dr. MUTER seconded the resolution, which was carried unanimously.

The CHAIRMAN said he thought they must make it a joint concern, and congratulate one another on having had a very good discussion. He only hoped that from the various opinions put forth by the public analysts on the one side, and by the representatives of Somerset House on the other, there would result a greater concensus of opinion and more good feeling one towards the other.

APPENDIX.

LACTIC ACID AND THE LACTATES AS FOOD PRODUCTS.

By Prof. William Ripley Nichols,

of Boston, Mass., U.S.A.

In asking your attention for a few moments to the manufacture of lactic acid and of the lactates on the large scale, I desire to say that I am not personally interested in a pecuniary way either in the manufacture or sale of these products. The application of the process which I have to describe was due to a friend of mine, Mr. Charles E. Avery, of Boston, and when the matter was brought to the attention of certain capitalists I was requested to examine and report upon the process, which is, certainly, of considerable interest to the chemist, and to the sanitarian as well.

When milk becomes sour, spontaneously as we say, the sourness is due to the presence of *lactic acid*, which was first extracted from sour milk by Scheele in 1780. The sugar of the milk has undergone a chemical change, as a result of which this acid has been formed. It is not alone from milk, however, that lactic acid may be obtained, for the fermentation of many vegetable substances gives rise to the formation of the same acid; thus, it is found in sauerkraut, in the fermented juice of the beet, and may be produced from almost any saccharine or amylaceous substance. When we say that milk becomes sour spontaneously, we speak from a microscopic standpoint: if we examine the matter microscopically, we find that the change is accompanied by the appearance and development of a multitude of minute organisms belonging to that order of beings which we speak of collectively as *bacteria*. The organisms which bring about this peculiar change we speak of as the lactic ferment.

Lactic acid is no new substance, and certain lactates,—as the lactate of soda, the lactate of lime, the lactate of zinc, &c.—have been prepared on the small scale and have been used to some

extent in medicine. The method hitherto employed for the production of these substances has been one giving rise to the extremely offensive odours which accompany the decay of a mixed mass of animal and vegetable substances. In fact, the operation was hardly fit to be carried out in any ordinary laboratory. In the new process the material employed is clean Indian meal, that is, the meal obtained by grinding Indian corn, or maize, and, if the process be properly conducted, the only odour which is perceived is agreeable rather than otherwise. I will attempt to describe the process briefly.

The first point is the preparation of the ferment. The minute details of the procedure being of the nature of a trade secret. I am not myself familiar with them: in principle, however, it consists in the application of the method of cultivation which has proved so fruitful in the hands of the eminent specialist, M. Pasteur. As we know, the air about us contains the germs of many different sorts of organisms, among them those which, if they fall into proper liquids, are capable of bringing about the lactic fermentation. These are not, however, the only organisms which would fall into a vessel of milk if it were exposed to the air. The alcoholic, the acetic, the butyric ferments, or their germs, are present as well, and will also bring about their respective fermentations under favourable circumstances. The principle of the method now under consideration consists in the cultivation of the lactic ferment to the exclusion of all other sorts by arranging the temperature and other surrounding conditions so as to be most favourable to the growth of the peculiar organism which is able to change sugar and starch into lactic acid. These organisms multiply to the exclusion of other forms: then a quantity of milk or starch is fermented in the presence of ground chalk, which neutralises the acid as it is formed, and produces the neutral lactate of lime, the whole mixture becoming a solid mass of crystals. This mass of neutral lactate of lime, containing the organisms which give rise to this peculiar fermentation, is what is known technically in the manufactory as the "ferment."

Thus much with reference to the preparation of the "ferment:" the actual process of manufacture is as follows: Large wooden vats are employed, and into each is put one ton of meal, two tons of water, and half a ton of bolted whiting. Then a barrel of "ferment" resulting from a previous operation is added, and the whole well mixed together. In about eight hours the temperature of the mass has risen to 48° Centigrade. A block tin

foil, through which cold water circulates, is then inserted in the vat, and allowed to remain for from 12 to 15 hours, the temperature being carefully maintained at 47° C. This is an important point in the process, because, if the temperature falls below 40° C. the fermentation ceases, while if it rises to 52° the ferment is killed. At the temperature of 47° C. fermentation goes on rapidly, torrents of carbonic acid gas are evolved, and the whole mass seems to be in most active ebullition. This evolution of carbonic acid is most rapid from the sixth to the fifteenth hour; at this point the cooler is usually removed, as thereafter the chemical action becomes less violent and maintains the temperature at the right point. After about four days, as a rule, and without further treatment, the whole mass becomes solid owing to the formation of crystals of the neutral lactate of lime, but the action goes on slowly for a day or two longer. I will not trouble you with details as to the purification of the crystals, as to the drying of the products, and as to other manufacturing details, which involve nothing which is essentially new in principle. By treating the neutral lactate of lime with just enough sulphuric acid, the lime is converted into sulphate of lime and the lactic acid set free; the sulphate of lime is removed by filtration, and the lactic acid evaporated in the vacuum pan until it reaches the required degree of concentration. If only one half of the requisite quantity of sulphuric acid is added, there is formed the bilactate or acid lactate of lime, which is, to be sure, not a perfectly definite compound; but this compound and the lactic acid of various grades are the principal commercial products.

The next question is, to what uses are these products put? The answer, in a general way is, that it is intended to offer them as substitutes for other more expensive substances already in use in the arts and in the household. The acid lactate of lime can replace the more expensive cream of tartar as a mordant in dyeing, and the acid itself is capable of useful application; but it is principally in connexion with articles of food that we have to consider these products. The most important use—at least in the United States—is in raising bread. In the States baking-powders are used to an enormous extent in making bread. In many parts of the country rolls—or *biscuits*, as we call them—prepared in this way are eaten morning and evening hot and fresh from the oven. It was at first proposed to mix the acid lactate of lime and the bicarbonate of soda in proper proportions, and sell the mixture as a baking-powder; but this has proved imprac-

ticable since, owing to the deliquescent character of the neutral lactate of lime, such a mixture gradually undergoes decomposition, and becomes useless for the intended purpose. The two powders are therefore supplied separately, with directions as to the proper proportions. A strong solution of lactic acid, containing 40 per cent. of the real acid, is also put upon the market to be used for the same purpose, three tea-spoonfuls of the acid and one tea-spoonful of soda being successively incorporated with the dough.

Another use of the acid is as a beverage: mixed with water, and sweetened, it has an acid flavour, which is very agreeable to most persons. This may seem a matter of small importance commercially, but the quantity of beverages of this character consumed with us, as in England, is very great. Of course it can be charged with carbonic acid, and bottled, just as other so-called lemonades are sold. I believe the acid (a 10 per cent. solution) is already on sale in London for this purpose, but, as I do not wish to be an advertising medium, I must leave it to be brought to your attention in other ways.

Still another use is as a table acid. The acid is less sharp than vinegar, and what its future in this direction may be I do not venture to predict.

The most important question of all remains: Is the acid wholesome, and are the uses suggested above legitimate uses from a sanitary point of view? I dare say there are others here who can speak with more authority on these points than I can. I am not a medical man, although I have been long interested in sanitary matters.

I believe there is no question as to the wholesomeness of sour milk, at least in reasonable quantities, and it is a staple article of food in many localities. With us—as I presume is the case in England also—it is thought that there is nothing more wholesome than bread and cakes raised with sour milk and soda. The great trouble is that, the sour milk not being of a uniform degree of sourness, there is great danger of spoiling the bread with an excess of soda, or of having sour bread, on account of not adding soda enough. This trouble is, of course, obviated by the use of an acid of known and invariable strength. The lactate of soda (or the lactate of lime and soda, which results if the acid lactate of lime be employed) would no doubt be quite as wholesome as the Rochelle salt which is left in bread raised with a cream of tartar powder. I am not aware of any accurate experiments on

the physiological action of the lactates taken in this way, but the general effect of the compounds seems to be sedative and slightly soporific.

How far the use of the various acid beverages which are consumed—especially in the summer, to an enormous extent—how far such use is advantageous, and what dangers there may be in excess, I will not attempt to investigate. At any rate, sour milk or a pure lactic acid is probably as wholesome a substance as can be used for the purpose. The opinion has also been expressed by medical men that, as an anti-scorbutic, lactic acid should rank with citric acid, and that it should form a part of the supply of vessels fitting out for Arctic voyages.

There is one other point to which I should allude. I saw recently an article by Dr. Richardson, in which he states that lactic acid is excreted in the system in the case of certain diseases. Lactic acid, or rather a variety of lactic acid called sarcolactic acid, has been thought to be a normal constituent of the gastric juice and of healthy muscle; and, I presume, the acid referred to by Dr. Richardson is sarcolactic acid, and not the lactic acid of fermentation. Although these two substances have the same percentage composition their chemical action is quite different, and their physiological action would probably not be the same. At any rate, even if the lactic acid of fermentation were formed in the system under certain abnormal conditions, it does not follow that the acid would be unwholesome to a person in normal health, any more than it follows that sugar should be banished from among articles of food, because in diabetes, for instance, a sort of sugar is found in the system, and eliminated in the urine.

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