A COMPARISON OF THE ORGANIC CARBON AND NITROGEN RESULTS
OBTAINED BY DR. FRANKLAND AND THE COMPANIES' ANALYSTS
FROM THE WATERS SUPPLIED BY THE METROPOLITAN WATER
COMPANIES.

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(Read at the Meeting, May 1, 1895.)

ONE of the most important duties a public analyst is called upon to discharge is to advise a sanitary authority as to the quality of the public water-supply, especially with reference to pollution by organic matter. In the districts supplied by the London Water Companies it occasionally happens that the public analyst's opinion as to the quality of the water is opposed to that of Dr. Frankland, who reports monthly to the Local Government Board. This arises from the fact that on the one hand Wanklyn's "ammonia" process is used, and, on the other, Frankland's "combustion" process is employed. It seems late in the day to raise the question of the reliability of Frankland and Armstrong's combustion process, but as the matter is of great public importance, and has, so far as I know,* never been publicly discussed since the historical dispute between its authors and Mr. Wanklyn, I venture to bring to your notice a comparison of the results obtained by it in the analyses of the London Companies' water made by Dr. Frankland on behalf of the Local Government Board and by the chemists employed by the Water Companies. These analyses are published in the monthly reports of the Official Water Examiner to the Local Government Board, from which documents I have taken my data.

Dr. Frankland claims for his process that it accurately determines the quantity of carbon and nitrogen contained in the organic matter present, and, further, that the ratio of carbon to nitrogen indicates its origin.

If the process gave accurate results, Dr. Frankland's figures should differ little

* This paper was written in June, 1894.

from those of the companies' chemists, and although the samples taken in the same month of any one of the companies' water, analysed by either, may possibly have contained a little more or less organic matter, the organic matter must have had a fairly constant composition; therefore the ratio of carbon to nitrogen should be practically the same in each case.

In the table on the opposite page I have placed side by side the ratio of carbon to nitrogen (nitrogen = 1) shown in the results obtained by the companies' analysts and by Dr. Frankland during the three years, 1891, 1892, and 1893.

I should mention that Dr. Frankland's analyses include only one sample of each company's water per month, but the companies' analysts examine several. I have taken in every case the mean of the latter, but much greater discrepancies are shown by particular samples.

It will be seen by this table that, with very few exceptions, Dr. Frankland's results differ greatly from the others, and, except in the case of the Kent Company, show a much higher ratio of carbon to nitrogen, and, further, that the ratios are much less uniform.

The ratios of carbon to one of nitrogen in the two sets of results vary as follow :

1891.			Companies' Analysts			Dr. Frankland.		
New River ...	...	...	2·9	to	4·4	...	3·6	to 8·1
East London ...	...	...	3·3	„	4·3	...	5·2	„ 9·6
Chelsea ...	...	...	3·3	„	5·5	...	3·9	„ 10·5
West Middlesex ...	...	...	3·3	„	5·3	...	3·6	„ 10·0
Lambeth ...	...	...	3·5	„	6·7	...	4·1	„ 9·8
Grand Junction ...	...	...	3·2	„	5·6	...	3·8	„ 7·9
Southwark ...	...	...	3·6	„	6·2	...	3·4	„ 9·5
Kent ...	...	...	3·8	„	22·1	...	3·4	„ 6·6
1892.								
New River ...	...	...	3·0	„	4·8	...	4·1	„ 11·2
East London ...	...	...	3·1	„	5·0	...	4·9	„ 9·8
Chelsea ...	...	...	3·6	„	4·8	...	6·2	„ 10·5
West Middlesex ...	...	...	2·6	„	5·3	...	6·3	„ 10·7
Lambeth ...	...	...	3·2	„	4·9	...	5·5	„ 10·4
Grand Junction ...	...	...	3·1	„	5·6	...	6·1	„ 9·4
Southwark ...	...	...	3·2	„	5·2	...	5·4	„ 10·5
1893.								
New River ...	...	...	2·1	„	4·5	...	3·8	„ 8·3
East London ...	...	...	3·1	„	4·0	...	2·1	„ 8·1
Chelsea ...	...	...	2·3	„	4·0	...	4·5	„ 10·3
West Middlesex ...	...	...	2·4	„	4·7	...	4·8	„ 9·3
Lambeth ...	...	...	2·6	„	4·8	...	6·0	„ 9·6
Grand Junction ...	...	...	2·9	„	4·9	...	3·6	„ 9·0
Southwark ...	...	...	2·7	„	4·8	...	3·9	„ 11·4

According to these results the Companies' chemists (except the Kent Company's) find that the composition of the organic matter in the water nearly approaches that of animal matter, while Dr. Frankland's rather indicate that it is generally of vegetable origin. In fact, the two sets of results differ almost completely. The actual analytical results show many remarkable and striking discrepancies. In the great

TABLE SHOWING RATIO OF CARBON TO NITROGEN (NITROGEN = 1) IN THE RESULTS OF ANALYSES OF THE WATER SUPPLIED TO LONDON BY THE METROPOLITAN WATER COMPANIES

MADE BY DR. FRANKLAND AND THE WATER COMPANIES' ANALYSTS.

1891.

Name of Water Company.	JANU-ARY.		FEBRU-ARY.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		OCTOBER.		NOVEMBER.		DECEMBER.	
	Company's Analysts.	Frankland.	Company's Analysts.	Frankland.	Company's Analysts.	Frankland.	Company's Analysts.	Frankland.	Company's Analysts.	Frankland.	Company's Analysts.	Frankland.	Company's Analysts.	Frankland.	Company's Analysts.	Frankland.	Company's Analysts.	Frankland.	Company's Analysts.	Frankland.	Company's Analysts.	Frankland.	Company's Analysts.	Frankland.
New River	3.8	3.6	2.9	8.1	3.4	7.1	4.1	3.3	6.9	7.7	3.3	6.8	4.1	4.6	4.1	5.3	3.7	5.1	3.9	5.4	4.4	4.6	3.8	5.2
East London	4.1	5.5	4.2	6.6	4.1	5.6	3.3	6.9	3.9	7.7	4.1	7.8	3.6	6.1	3.7	5.2	4.1	7.1	3.4	6.9	4.1	4.6	3.8	6.3
Chelsea	4.1	6.1	4.6	7.3	3.6	4.4	4.4	8.4	3.6	10.5	4.1	6.3	3.3	5.6	5.5	5.4	3.7	6.3	3.5	6.3	3.8	4.6	3.5	3.9
West Middlesex	3.5	3.6	5.3	8.8	3.5	8.3	3.7	3.7	3.6	7.8	3.6	7.3	3.3	5.7	3.6	5.5	4.3	7.5	4.3	8.5	4.8	10.1	4.7	6.4
Lambeth	6.7	4.1	4.4	9.5	3.5	6.7	4.6	4.1	4.2	8.5	3.8	6.0	3.6	7.1	3.9	6.9	4.5	7.4	4.7	9.8	4.7	8.2	4.4	6.4
Grand Junction	3.4	3.8	5.1	7.3	3.5	6.9	3.8	6.6	3.5	7.6	3.4	5.4	3.5	6.1	4.1	6.3	4.1	7.9	3.2	7.1	5.6	6.3	4.9	7.2
Southwark	4.1	3.4	5.8	7.9	4.6	9.5	4.1	6.2	4.6	7.9	4.7	3.9	3.6	8.1	4.7	4.2	4.1	7.3	6.2	8.7	5.3	6.6	5.1	6.2
Kent	5.6	4.7	12.9	4.4	16.2	6.6	8.2	5.5	4.2	4.6	10.1	5.2	13.5	5.2	3.8	4.9	6.2	3.5	6.8	3.4	22.0	4.7	22.1	3.4

1892.																								
New River	3.9	7.1	3.1	5.1	4.3	5.5	3.5	5.1	3.5	4.1	3.9	4.8	3.7	5.9	4.1	5.1	4.3	6.9	3.5	11.2	4.8	9.1	3.8	4.5
East London	5.1	6.9	3.3	5.4	3.7	6.8	3.9	5.9	4.2	4.9	3.9	5.9	3.1	8.8	3.5	6.7	3.7	5.5	4.1	8.1	4.5	9.8	3.9	5.5
Chelsea	4.8	7.4	4.6	7.1	4.6	9.1	3.7	7.9	4.2	8.1	3.8	6.9	3.6	6.2	3.9	9.7	4.8	6.8	4.2	10.5	4.6	10.5	3.6	10.2
West Middlesex	3.5	8.1	5.3	7.1	4.6	9.2	4.5	6.4	4.9	7.5	2.6	6.3	3.6	6.5	3.1	9.1	3.4	10.7	3.3	9.9	5.3	8.1	4.5	7.3
Lambeth	3.7	9.7	4.9	5.8	4.2	8.8	4.4	5.5	4.2	7.5	4.1	6.5	3.7	5.6	3.2	6.7	3.3	9.9	4.1	10.4	4.9	9.1	4.2	9.3
Grand Junction	3.4	6.1	4.7	6.7	3.9	9.4	4.3	7.1	4.2	8.2	3.4	6.4	3.4	8.1	3.3	7.8	3.1	7.4	3.7	7.9	5.6	6.5	4.6	7.8
Southwark	3.4	6.3	5.2	5.4	4.8	8.3	4.1	7.1	4.2	6.3	3.9	6.1	4.1	5.4	3.7	7.4	3.2	10.3	3.9	10.5	4.7	10.2	4.7	6.6

1893.																								
New River	3.1	4.3	3.8	4.1	4.5	5.3	2.7	7.1	3.6	7.6	3.1	7.3	2.7	3.8	2.7	8.3	2.1	6.1	2.8	7.6	2.8	5.1	2.6	8.3
East London	3.7	4.9	3.8	8.1	4.1	4.5	3.4	7.1	3.4	2.1	3.4	8.1	3.2	5.4	3.5	6.4	3.1	7.1	3.3	6.5	3.2	6.6	3.5	6.6
Chelsea	4.1	5.9	3.7	6.6	3.9	7.1	3.8	4.5	2.4	8.8	3.2	7.1	2.3	5.8	2.6	4.5	2.6	5.5	2.5	4.7	2.5	10.3	3.3	8.8
West Middlesex	4.1	4.8	4.7	7.6	4.7	6.2	3.5	6.1	3.4	8.4	3.5	8.7	3.3	7.3	3.4	8.2	2.4	5.2	3.4	8.1	3.6	8.5	3.4	9.3
Lambeth	3.8	6.1	4.8	6.1	4.6	6.1	3.4	9.1	3.3	6.8	3.1	7.5	2.9	7.1	3.3	7.1	2.6	6.7	3.8	6.8	3.4	7.1	4.1	9.6
Grand Junction	4.2	5.1	4.9	6.1	3.9	6.1	3.4	5.7	2.9	6.6	3.1	7.6	3.1	4.9	3.1	3.6	2.9	7.3	3.1	7.3	3.4	6.7	3.6	9.1
Southwark	4.2	3.9	4.8	4.8	4.2	7.6	3.2	4.8	3.3	5.4	3.1	9.6	3.2	5.8	3.1	5.1	2.7	4.4	3.5	5.1	3.3	7.1	4.1	11.4

majority of cases the organic nitrogen found by the Companies' chemists is much higher, and the organic carbon often much less, than Dr. Frankland's. A few of the most noticeable are the following :

1891.—As compared with Dr. Frankland's results, the Kent Company's chemist found nearly twice as much nitrogen in January, three times as much in February, about half as much in March, less than half in July, less than one-third in October, one-fourth in November, and less than one-third in December.

The New River Company found twice as much nitrogen in February, more than three times in March, more than twice in May and June, and nearly twice in October.

The East London Company found more than twice as much nitrogen in April, and nearly twice in May and November.

The Chelsea Company's nitrogen was more than twice as much in May.

The West Middlesex Company's nitrogen was more than twice in March, May, and November.

The Lambeth Company's nitrogen was nearly twice in February, May, and November.

The Grand Junction Company's nitrogen was more than twice in May.

The Southwark Company's nitrogen was nearly twice in February and May, and more than twice in March.

1892. *Jan.* The West Middlesex and the Southwark Companies' nitrogens were nearly, and the Lambeth Company's more than, twice.

The New River Company's carbon was one-half.

March. The East London, Chelsea, and Lambeth Companies' nitrogens were nearly, the New River Company's exactly, and the West Middlesex and Grand Junction more than, twice.

April. The East London Company's nitrogen was nearly, and the Chelsea Company's more than, twice.

May. The West Middlesex and Lambeth Companies' nitrogens were nearly, and the Chelsea and Grand Junction Companies' exactly, twice.

June. The West Middlesex and Grand Junction Companies' nitrogens were nearly twice.

July. The West Middlesex Company's nitrogen was nearly, the East London and Grand Junction Companies' more than, twice, and the West Middlesex more than three times.

August. The East London Company's nitrogen was nearly twice, the Grand Junction more than twice, and the West Middlesex more than three times.

Sept. The New River Company's nitrogen was nearly, the West Middlesex, Lambeth, and Southwark Companies' more than, twice.

Oct. The West Middlesex, Lambeth, and Southwark Companies' nitrogens were nearly, and the New River more than, twice.

	<i>Dec.</i>	The Chelsea Company's carbon was less than half.
1893.	<i>Jan.</i>	The Chelsea Company's carbon was less than one half.
	<i>Feb.</i>	The East London Company's carbon was about one half.
	<i>March.</i>	The Lambeth and Grand Junction Companies' carbons were about, and the Southwark exactly, one half.
	<i>April.</i>	The East London Company's nitrogen was nearly, and the New River, Lambeth, and Grand Junction Companies' more than, twice.
		The Chelsea Company's carbon was less than one half.
	<i>May.</i>	The Chelsea, Lambeth, and Grand Junction Companies' nitrogens were nearly, and the New River and West Middlesex Companies' more than, twice.
		The Chelsea Company's carbon was less than one half.
	<i>June.</i>	The Lambeth and Grand Junction Companies' nitrogens were nearly, and the New River, East London, West Middlesex, and Southwark Companies' more than, twice.
		The Chelsea Company's carbon was less than one half.
	<i>July.</i>	The East London Company's nitrogen was nearly, the New River Company's exactly, and the West Middlesex and Lambeth Companies' more than, twice.
		The Chelsea Company's carbon was less than one half.
	<i>August.</i>	The West Middlesex and Lambeth Companies' nitrogens were exactly twice, the East London more than twice, and the New River three times.
		The Chelsea Company's carbon was less than one half.
	<i>Sept.</i>	The West Middlesex Company's nitrogen was twice, the East London and Lambeth Companies' more than twice, and the New River and Grand Junction Companies' nearly three times.
		The Chelsea Company's carbon was less than one half.
	<i>Oct.</i>	The New River and West Middlesex Companies' nitrogens were more than twice.
	<i>Nov.</i>	The New River Company's nitrogen was twice, and the East London, West Middlesex, and Grand Junction Companies' nearly twice.
		The Chelsea Company's carbon was less than one third.
	<i>Dec.</i>	The New River Company's nitrogen was nearly, and the West Middlesex, Lambeth, Grand Junction, and Southwark Companies' more than, twice.
		The Chelsea Company's carbon was little more than one half.

As might have been anticipated, the organic nitrogen results show the most frequent discrepancies, but it is curious that the carbon results of the Chelsea Company's analyst should have been so very much less than Dr. Frankland's each month (with a few exceptions), from December, 1892, to December, 1893.

These comparisons show very plainly how extremely unreliable the process is; and if three sets of analyses by eminent chemists (one of them the originator), who

have had almost daily practice with it, differ so enormously, how can an analyst, having only to apply it very occasionally, be expected to place any faith in it?

Since the above was written, the Companies' analysts, in their report for July, 1894, explain the discrepancies between Dr. Frankland's results, in the case of the Chelsea Company's water, and their own, by stating that the samples were taken from standpipes, which were found, on inquiry, to be supplied by the New River Company.

They make no reference to the equally serious and more numerous discrepancies in the results of the other Companies' waters, but in their report for August, 1894, they state: "We have recently adopted certain modifications in the estimation of organic nitrogen, suggested by Dr. Frankland. . . . These seem to give more accurate results." I have compared all the results published since, and find that the differences are not so great as formerly, but in many instances they are large enough to completely condemn the process.

The Wet Assay for Copper. R. S. Dulin. (*Journ. Amer. Chem. Soc.*, 1895, xvii., pp. 346-351.)—The methods in general use for rapidly determining copper are the cyanide method, the iodide, and the electrolytic.

In the cyanide method, potassium cyanide is run into an ammoniacal solution of copper until the blue colour is discharged. The reaction is—

The following precautions should always be observed:

1. The bulk of the liquid to be titrated should always be the same.
2. The solution must be at the temperature of the laboratory.
3. The amount of ammonia added must be nearly constant. Neglect of these precautions may cause errors of several per cent.

Cadmium interferes with the reaction, and to obviate this the author suggests precipitating the copper by boiling with aluminum foil, leaving cadmium in solution, dissolving the precipitated copper in HNO_3 , treating the solution with NH_4OH , and then titrating. Silver also interferes, but in a regular manner, and when the amount is known may be allowed for.

The iodide method depends on the reaction

the amount of iodine being determined by $\text{Na}_2\text{S}_2\text{O}_3$. The precautions to be observed are—

1. The presence of iron in about equal amount with the copper requires more $\text{Na}_2\text{S}_2\text{O}_3$, increasing the amount of copper two or three per cent.
2. The solution should be titrated cold.
3. Large amounts of alkaline salts, especially sodium sulphate, decrease the amount of copper.
4. Bismuth interferes with the end reaction.

With the modification of precipitating the copper first with aluminum, the results are nearly as accurate as with the modified cyanide method, but more time is required.

The chief source of error in the electrolytic method is the deposition of other metals with the copper. The author obviates this by making the deposition from a solution containing a large amount of nitric acid. The best results are obtained with 20 c.c. of HNO_3 to 150 c.c. of solution, but a stronger current than usual is required to precipitate all the copper.

The following are the results obtained on estimating a copper matte containing 20·15 per cent. of copper as determined by many analyses by different assayers, another containing 28 per cent., and an ore containing 30·18 per cent. :

Various Analyses.			Cyanide Method.	Iodide Method.	Electrolytic.
		Copper.			
Matte ...	...	20·15	20·15	20·25	20·045
Matte ...	...	28	27·95	28·35	28·15
Ore ...	...	30·18	30·20	30·3	30·05

In the cyanide and iodide methods the copper was first precipitated with aluminum foil.

The general conclusion arrived at is that, while the iodide method is usually one-enth to three-tenths per cent. too high, the electrolytic method is too high or too low according to the amount of metallic substances that can be precipitated by the current. The cyanide method gives results practically correct. C. A. M.

The Separation of Solid and Liquid Fatty Acids. E. Twitchell. (*Journ. Amer. Chem. Soc.*, 1895, xvii., pp. 289-295.)—The most promising processes are based on the greater solubility in ether of the lead soaps of the liquid acids first noticed by Varrentrapp. Having failed to obtain a satisfactory separation, the author has made a study of various methods based on this process.

1. **Muter's Process** (ANALYST, 1889, p. 61).—The following results were obtained with lard fatty acids prepared with the usual precautions.

			Iodine absorbed per cent.	
Lard	...	...	...	56·27
Fatty acids	...	...	...	{ 58·49
				{ 59·26
Liquid acids by above process	...	...	...	94·06

The iodine number of the liquid acids is in agreement with that found by Muter for lard, but the author proves that lead soaps of saturated fatty acids are soluble in ether, 100 c.c. dissolving 0·015 of the lead salts of purified commercial stearic acid (Iodine No. 0) at 0° C.* Another serious objection is the oxidation caused by the exposure of the lead soaps to the air.

2. **A Modification of Jean's Method.** (*Chimie Analytique des Matières Grasses.*)—Four grammes of the same lard fatty acids were dissolved in 50 c.c. of 95 per cent. alcohol and 2·5 grammes of lead acetate in 20 c.c. of the same alcohol added, both solutions being hot. There was an immediate precipitate, which was allowed to stand at the laboratory temperature for one hour, and then at 15° C. for another hour. A part was then filtered into a separating funnel, treated with ether and HCl, the acids washed and dried in a current of CO_2 , their iodine number determined, and their

* Cf. *Hehner, ANALYST*, xvii., p. 181.

percentage in the original solution calculated. The precipitate was washed with 95 per cent. alcohol, decomposed with HCl, and the solid fatty acids dried and weighed. Their iodine number was also determined. The results obtained were :

	Per cent. obtained.	Iodine No.
Solid fatty acids	46·24	4·9
Liquid fatty acids... ..	51·82	103·37

These figures indicate a fractional precipitation in which all the solid and part of the liquid acids were precipitated. The difference between the iodine number of the liquid acids by this process and by Muter's, shows that in the latter case a considerable amount of saturated or of oxidized fatty acids must have been present.

To determine whether the liquid acids were quite free from solid acids, and also whether the process was really a fractional precipitation, the author made the following experiment : 4 grammes of lard fatty acids were dissolved in 95 per cent. alcohol, precipitated with lead acetate, and the precipitate filtered after an hour. Ten c.c. of the filtrate were drawn off and the fatty acids recovered, while the remainder of the filtrate was kept at 0° C. for an hour, when there was an additional precipitate, which was also filtered off.

The iodine absorbed by the fractions was :

	Amount obtained. Gramme.	Iodine No.
Lard fatty acids	—	62·57
Fatty acids from filtrate at 15°	0·02675 (46·81 %)	109·35
„ „ precipitate at 0°	0·1020	—
„ „ filtrate at 0°	0·1915	118·02

The fatty acid obtained from the precipitate at 0° was probably pure oleic acid, since it melted at 7° C., and must have had an iodine number of about 90 per cent. to make the iodine number of the mixture 109·35.

It is thus plain that the process is not a quantitative separation, but a fractional precipitation, in which the solid acids are precipitated first, then the oleic acid, and lastly the linolic acid.

Though no quantitative separation is effected, the proportion of liquid acids can be calculated from the results. The percentage of liquid acids in the alcoholic filtrate is calculated from the fraction drawn off. This is multiplied by the iodine number of these acids, and deducted from the iodine number of the original fatty acids, and the result represents oleic acid. Dividing this by 0·9 gives the percentage of oleic acid precipitated with the solid acids. Adding this to the liquid acids in the filtrate gives the total liquid acids. Thus, in the case of the last sample, $46·81 \% \times 109·35 \% = 51·19$. Deducting from 62·57 gives 11·38. Divide by 0·9 = 12·64 oleic acid in the precipitate. Add to 46·81 = 59·45 total liquid acids, the iodine number of which is

$$\frac{62·57}{59·45} = 105·2.$$

The linolic acid may be calculated from the iodine absorption of the liquid acids. 109·35 represents 78·5 oleic acid and 21·5 linolic acid. $21·5 \times 46·81 = 10·06$ linolic acid in original fatty acids.

3. **Rose's Process** (*Zeit. für Anal. Chemie*, 1886) consists in shaking up an ethereal solution of the fatty acids with litharge. The author substituted petro-

leum spirit for ether, and obtained the following results with the lard fatty acids used in the last experiment :

	Amount per cent.	Iodine No.
Solid acids	44.70	3.02
Liquid acids	55.10	108.66

This method has the disadvantages that it can only be reliable when the fat is quite fresh and great care taken to prevent oxidation. Thus the same sample of lard fatty acids, after standing seven days in a closed jar, gave :

	Iodine No.
Solid acids	10.1
Liquid acids	101.7

The author's general conclusion is that Jean's process, with the addition of taking the iodine absorption of the original acids and of those in solution, will give accurately the percentage of liquid and solid acids in a fat. And although this is too cumbersome for general commercial work, it is as yet the only positive solution of the problem.

C. A. M.

Action of Formalin on Food Stuffs. T. Weigle and S. Merkel. (*Forschungsber.*, etc., 1895, ii., 91; through *Chem. Zeit. Rep.*, 1895, p. 142.)—Milk containing formalin in the proportion of 1 : 5,000 could be preserved at 25° C. for 100 hours; when the proportion was 1 : 10,000 the milk remained good for 50 hours at 25° C. Formaldehyde so changes the albuminoids of milk that they are no longer soluble in a mixture of sulphuric and acetic acids. Moreover, the casein can only be precipitated in thick clots from milk containing formalin, not in the fine flocculent condition characteristic of the casein from normal milk. On this ground alone the addition of formalin to milk may be deemed inadmissible. Formaldehyde renders the albuminoids of milk less digestible, an addition of 1 of formalin to 500 of milk, for example, rendering the casein insoluble in pepsin and hydrochloric acid.

Butters to which formalin has been added increase in acidity very slowly. The saccharification of starch by diastase is favoured by formaldehyde, while alcoholic fermentation is much delayed.

A. G. B.

[Attempts to preserve fish for the market by means of formalin failed in the abstractor's hands on account of the hardening effect of the formaldehyde. This appeared to be due to the coagulation of albuminoids, the samples being thus rendered so hard as to be unsaleable, even by solutions containing 1 part of formalin in 2,000.]

On the Employment of Phenylhydrazine for the Quantitative Estimation of Dextrose, Lævulose, and Saccharose. C. J. Lintner and E. Kröber. (*Zeitschrift für das gesammte Brauwesen*, 1895, No. 19, pp. 153-155.)—The circumstance that glucosazone is almost insoluble in hot water and is thereby distinguishable from the other commonly occurring osazones led the authors to attempt to make use of this property as a means of effecting more reliable quantitative determinations of sugars than is possible by the copper reduction methods or polarization. The process and results may be summarized as follows :

Pure Dextrose.—A solution of dextrose (containing between 0.1 and 0.2 gramme per 20 c.c.) is heated to 100° for one and a half hours with 1 gramme phenylhydrazine and 1½ grammes 50 per cent. acetic acid, and, following the addition of 20 c.c. boiling water, the osazone is collected on a tared filter moistened with hot water, washed with about 60 c.c. boiling water, and dried for three hours at 105–110° C. If the solution is more concentrated the washing of the precipitate is retarded and incomplete; where a larger quantity of wash water is used, a greater proportion of the osazone dissolves—0.1 gramme of dextrose yields 0.1 gramme of osazone; and though this is considerably below the theoretical yield, the results, when the conditions laid down are rigidly adhered to, are remarkably concordant.

Pure Lævulose.—The process is performed in the same manner as for dextrose, but the yield of osazone is somewhat greater (1 : 1.43).

Pure Saccharose.—Previous inversion by dilute HCl and the addition afterwards of sodium acetate is necessary, or the production of osazone is incomplete. The yield is 0.133 gramme of osazone per 0.1 gramme sugar.

Dextrose with Maltose and Dextrin.—Where maltose is present, one and a half hours' heating is requisite to completely form its osazone, and, owing to the difficulty experienced in washing the whole of this out, the dextrose figures are slightly increased (proportion 0.1 : 0.104). In the case of associated dextrin the formation of dextrosazone is retarded, and requires a longer exposure to heat, viz., two hours. The factor is the same as that employed with maltose, but where both are present at the same time the yield is slightly increased (0.1 : 0.106).

The presence of saccharose naturally causes the osazone value for dextrose to come out too high. C. S.

Contribution to the Study of the Ash of Cheese. G. Mariani and E. Tasselli. (*Staz. Sper. Ag. Ital.*, xxviii. 23.)—The authors have estimated the total ash, chlorine, lime, and phosphoric acid in 15 samples of cheese. The amount of salt (calculated from the chlorine) is naturally variable, being dependent on the mode of salting adopted. The proportion of phosphoric acid found was always greater than that necessary to form tribasic calcium phosphate, the proportion varying from 1.07 and 1.08 equivalents P_2O_5 to 1CaO in cheese made from sour milk, to 1.56 : 1 in Gorgonzola, 1.67 : 1 in skim-milk cheese, and 1.75 in Edam cheese. The largest quantities of lime and phosphoric acid were found in sheep's-milk cheese and in cheese made from sour milk, whence it follows that acidity does not prevent the precipitation of calcium phosphate with the curds.

The authors attribute the excess of phosphoric acid to the probable presence of acid phosphates. H. D. R.

LITERARY INTELLIGENCE.

A new work, entitled "The Chemistry of Urine; a Practical Guide to the Analytical Examination of Diabetic, Albuminous, and Gouty Urine," by Mr. Alfred H. Allen, is announced by Messrs. J. and A. Churchill. The book occupies about 200 octavo pages, and is illustrated.