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THE ANALYST.

OBITUARY.

WALTER WILLIAM FISHER, M.A., F.I.C.

THE late Walter William Fisher, M.A., F.I.C., Aldrichian Demonstrator of Chemistry in the University of Oxford, who died on February 7, in his 78th year, was one of the oldest members of the Society of Public Analysts, and acted as its President in 1889 and 1890. He was Public Analyst for the counties of Oxford, Berks and Bucks, and also for the city of Oxford, having held these posts for nearly forty years, and he was actively engaged in the duties appertaining to them up to within a week of his death.

He was educated at Worcester and Merton Colleges, Oxford, took a first-class in Chemistry in the School of Natural Science in 1870, and, with the versatility which characterised him, proceeded the next year to take a class in "Greats." He was shortly afterwards elected a Fellow of Corpus Christi College. His classical study was but an interlude, for he at once returned to his chemical work as assistant to the late Prof. Vernon Harcourt, and in the following year was appointed by Sir Benjamin Brodie as University Aldrichian Demonstrator in Chemistry, which post he held until his death. He was for six years, from 1874, lecturer in Chemistry at Balliol, and he acted on various occasions as Public Examiner for the University. He also acted as Examiner to the Institute of Chemistry from 1903 to 1907, and was a Member of Council of that body in 1893-1896, 1898-1901, and 1907-1910.

The transactions of the Chemical Society include papers by Fisher on "Manganese Tetrachloride" (1878) and "Lead Tetrachloride" (1878), while a paper in the "Proceedings" of the same Society appeared in 1892 on "Anhydrous Oxalic Acid." To the "Proceedings" of the Society of Public Analysts he contributed papers on "Alkaline Waters from the Chalk" (ANALYST, 1901), and "Alkaline Waters from the Lower Greensand" and "Indirect Estimation of Alkalies in Waters" (ANALYST, 1902). Six or seven years prior to his death he had been engaged in the compilation of a paper on "Some Variations of the Thames Water," which he hoped to read before the Society. He was a good geologist, and made a special study of the composition of well waters derived from various water-bearing strata, apart from the publication of the papers to which reference has been made. He was also all his life a keen field botanist.

During his Presidency of the Society of Public Analysts he gave valuable evidence on behalf of the Society before the Departmental Committee which was

appointed in 1899 by the President of the Local Government Board to inquire into the use of preservatives and colouring matters in foodstuffs.

Fisher's versatility was not confined to intellectual matters. He joined the Volunteers in 1860, and was a member of the 1st Surrey Rifles for eleven years, during which time he won many prizes for shooting; and at college he rowed in the Merton eight, and was the possessor of many cups for various branches of athletics.

Personally, he possessed a charming manner which faithfully expressed his gentle and cultured spirit, and he was a loyal and affectionate friend beloved by his colleagues and by many generations of pupils.

BERNARD DYER.

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PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.

ORDINARY MEETING, MAY 5, 1920.

HELD at the Chemical Society's Rooms, Burlington House, Mr. Alfred Smetham, President, in the chair.

A certificate was read for the first time in favour of Mr. Udolphus Aylmer Coates.

Certificates were read for the second time in favour of Misses Dorothy Gertrude Hewer, B.Sc. (London), Rita Catherine Hawkins Johnson, Messrs. Harold Hall, F.I.C., Geoffrey Trelawney Bray, A.I.C., Frank William George King, John Herbert Stubbs, M.Sc. (Victoria), F.I.C.

The following were elected Members of the Society: Messrs. Laurence Harry Mills, B.Sc. (Birmingham), A.I.C., Frederick Robertson Dodd, F.I.C.

The following papers were read: "Estimation of the Age of Ink in Writing," by C. Ainsworth Mitchell, M.A., F.I.C.; "Examination of Crude Chinese Camphor," by E. R. Dovey, A.R.C.S., A.I.C.; "A Volumetric Method of Estimating Iron," by H. Droop Richmond, F.I.C., and Edith M. Ison, B.Sc. (London).

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AN EXAMINATION OF CERTAIN MILK RECORDS.

By G. W. MONIER-WILLIAMS, M.A., Ph.D., F.I.C.

(*Read at the Meeting, April* 14, 1920.)

This paper deals with the results of the examination of certain series of milk records which have been placed at my disposal at various times during the last eight or ten years.

These records have been submitted to elementary statistical analysis, and the results, although far from complete, are, I think, of sufficient interest and importance to show the value of this method of dealing with milk records. I should mention that I have not in all cases been in a position to test the reliability of the actual analytical data, but have assured myself that the work has been conducted by skilled operators. All the fat analyses have, I believe, been carried out by the Gerber method. Although slight inaccuracies may possibly have arisen in some cases owing to the use of uncalibrated apparatus, and from other causes, they would not be sufficient to affect the broad conclusions which may be drawn from the results.

The first series is one of 4,825 samples of milk from single cows of one herd, taken over a short period. The experiments were carried out under the direction of Mr. Wilfred Buckley, Director of Milk Supplies, on his own herd at Moundsmere Manor, near Basingstoke, in 1915, and I am much indebted to him for placing the results at my disposal and allowing me to bring them before this Society.

The herd consisted of sixty-five dairy Shorthorn cows, counting only those which were in milk at the time. The milk of each cow, both morning and evening, was weighed, and the fat content determined, over a period of thirty-nine days—from April 18 to May 26, 1915. During the first part of this period, up to May 5, the cows were on winter rations, and were turned out during the day in a 2-acre paddock. During the last half of the period they were turned out to grass, and no concentrated food of any kind was given.

For the purpose of the experiments the cows were divided into three groups, according to the stages of the lactation period :

Group I.—Twenty-four cows which had calved from January 9 to March 25 of the year in which the records were taken.

Group II.—Twenty cows which had calved from October 15 to December 27 of the previous year.

Group III.—Twenty-one cows which had calved from June 1 to September 18 of the previous year.

As the period covered by the experiments advanced, several of the cows in Group III. dried off, so that at the end of the thirty-nine days only fourteen cows out of twenty-one in this group were giving milk.

The results obtained are shown in Table I. :

The actual percentages of samples falling below 3 per cent. of fat were as shown in Table II., while Table III. shows the way in which these samples deficient in fat were distributed throughout the herd.

TABLE I.

	Number of Samples.	Average Fat Content per Sample.	Average Daily Yield per Cow.	
			Milk in Pints.	Milk Fat in Pounds.
1. *Morning Milk.*				
(i.) *Separate groups :*				
(*a*) Winter rations—				
Group I.	430	2·87	13·6	0·50
Group II.	359	3·24	11·4	0·48
Group III.	348	3·66	5·6	0·26
(*b*) Grass fed—				
Group I.	502	2·87	14·4	0·53
Group II.	414	3·20	12·2	0·50
Group III.	361	3·36	6·4	0·27
(ii.) *Complete herd :*				
(*a*) Winter rations	1,137	3·23	10·5	0·43
(*b*) Grass fed	1,277	3·12	11·4	0·45
(*c*) Whole period	2,414	3·17	11·0	0·44
2. *Evening Milk.*				
(i.) *Separate groups :*				
(*a*) Winter rations—				
Group I.	432	4·17	9·1	0·49
Group II.	360	3·98	7·5	0·39
Group III.	348	4·46	3·6	0·21
(*b*) Grass fed—				
Group I.	496	4·06	9·6	0·50
Group II.	414	3·98	7·3	0·37
Group III.	361	4·32	4·1	0·22
(ii.) *Complete herd :*				
(*a*) Winter rations	1,140	4·20	6·9	0·37
(*b*) Grass fed	1,271	4·11	7·3	0·39
(*c*) Whole period	2,411	4·15	7·1	0·38
3. *Morning and Evening Milk together.*				
(i.) *Separate groups :*				
(*a*) Winter rations—				
Group I.	862	3·52	22·6	0·99
Group II.	719	3·61	18·9	0·86
Group III.	696	4·06	9·2	0·46
(*b*) Grass fed—				
Group I.	998	3·46	24·0	1·03
Group II.	828	3·59	19·5	0·88
Group III.	722	3·84	10·5	0·49
(ii.) *Complete herd :*				
(*a*) Winter rations	2,277	3·71	17·3	0·80
(*b*) Grass fed	2,548	3·61	18·7	0·84
(*c*) Whole period	4,825	3·66	18·1	0·83

TABLE II.—PERCENTAGE OF SAMPLES FALLING BELOW 3 PER CENT. OF FAT.

	Winter Ration Period.	Grass Fed Period.	Whole Period.
Morning Milk:			
Group I.	55·8 per cent.	57·6 per cent.	
Group II....	23·4 ,,	30·7 ,,	
Group III.	9·8 ,,	24·9 ,,	
Complete herd	31·6 ,,	39·6 ,,	35·8 per cent.
Evening Milk:			
Group I.	1·6 per cent.	4·6 per cent.	
Group II....	1·4 ,,	2·2 ,,	
Group III.	0·3 ,,	1·7 ,,	
Complete herd	1·2 ,,	3·0 ,,	2·16 per cent.

TABLE III.—DISTRIBUTION OF SAMPLES DEFICIENT IN FAT (MORNING MILK).

Milk fell below 3 per Cent. Fat on—	Number of Cows of—			Whole Herd.
	Group I.	Group II.	Group III.	
Nil occasions	1	1	6	8
1– 4 ,, ...	1	6	6	13
5– 9 ,, ...	2	3	4	9
10–19 ,, ...	4	7	4	15
20–29 ,, ...	9	2	1	12
30–37 ,, ...	7	1	—	8
				65 cows

TABLE IV.—DAILY MIXED MORNING MILK OF WHOLE HERD.

Per Cent. of Fat.	Number of Occasions.
2·79	1
2·89	1
2·93	1
2·95	1
2·96	1
2·97	1
2·98	1
2·99	2
3·00	4
3·01–3·09	9
3·10–3·19	11
3·20–3·29	3
3·30–3·39	2
3·50	1
	39

Table IV. shows the composition of the daily mixed morning milk of the whole herd, calculated from the fat percentage and yield given by each cow.

It will be seen from these results that :

1. The fat content of the morning milk is remarkably low throughout, especially in the case of cows which had recently calved.

2. The evening milk is, on the average, very rich in fat, the mean for the whole period being 4·15 per cent.

3. The sudden change from winter rations to grass has not had so great an effect as we might have expected, although the influence of the change can be seen clearly.

4. The rise in quality and corresponding fall in quantity as the lactation period progresses is very marked. The relative decrease in quantity is much greater than the relative increase in fat percentage, a relation which is reflected in the total amounts of milk-fat yielded at different stages of lactation. It has been pointed out by Crowther in 1905, and by Eckles and Shaw in 1913, that the actual rates of increase in milk-fat and decrease in yield are by no means even or gradual, but fluctuate considerably at different stages of the lactation period and under different conditions. But, for the purposes of this paper, it is sufficient if we take it that the general tendency is for the milk to become richer and for the yield to fall off as lactation progresses.

While the rise in fat percentage with progressing lactation is very evident in the morning's milk, it is not so marked in the evening's milk, in which the fat is higher during the first three months of lactation than during the middle period.

We can now compare these averages with those of the Aylesbury Dairy Company, published by Richmond.

By interpolation from Richmond's figures we can get the probable figures for Aylesbury dairy milk for the period April 18 to May 26. The comparison is shown in Table V. :

TABLE V.

	Morning.	Evening.	Mean.
Aylesbury Dairy Company :	Per Cent. Fat.	Per Cent. Fat.	Per Cent. Fat.
Averages for period 1906-1914	3·34	3·75	3·54
Aylesbury Dairy Company :			
Averages for 1915	3·50	3·71	3·60
Moundsmere herd :			
Averages of single cow samples	3·17	4·15	3·66
Moundsmere herd :			
Averages of mixed milk of herd	3·08	4·11	3·59

The figures on the lowest line are arrived at from the following considerations : The comparison of averages of single cow milks with those of mixed milks is not strictly permissible, by reason of the variation in the yield of milk from cows in different stages of lactation.

From Table I. it is evident that a low fat percentage corresponds in most cases to a high yield of milk. On mixing the milk, the fat content of the mixed milk will be affected to a greater extent by the more bulky samples, thus bringing the average fat content down. If we have, for instance, two samples, one of 6 quarts at 3 per cent. of fat, and the other of 2 quarts at 4 per cent. of fat, the average fat content of the samples will be 3·5 per cent., but, on mixing the two samples, the fat in the mixed milk will only be 3·25 per cent. I have therefore calculated from the fat percentage and milk yield in each case what would be the daily composition of the mixed milk of the whole herd, and then taken the averages from the figures thus arrived at. These averages are, I think, fairly comparable with Richmond's figures.

It would appear therefore that, judged by the final average, the milk of this herd is in the aggregate normal, and that it is the distribution of milk-fat which is at fault. At the same time, the actual quantity of milk-fat yielded by the Moundsmere herd is probably somewhat less than the Aylesbury Dairy Company average, owing to the difference in the quantity of morning and evening milk. If we take it that the yield of morning milk is 50 per cent. greater than that of the evening in both cases, there is approximately a difference of 3 per cent. in the total yield of milk-fat in favour of the Aylesbury Dairy milk—that is to say, if the average daily yield of milk-fat calculated from the Aylesbury figures is taken as 100, that of the Moundsmere herd is 97.

One of the prime causes of inequality in distribution of fat is admitted to be unevenness in intervals between milking. In this herd the milking intervals were approximately nine and fifteen hours—that is to say, the cows were milked at about 5 a.m. and again at 2 p.m. for the greater part of the period. Whether this is sufficient to account for the uneven distribution of fat is doubtful. Table VI. shows the effect of changing the milking intervals during the period when the herd was out to grass.

The herd had been divided for milking purposes into three squads, X, Y, and Z, each of these squads comprising an approximately equal number of animals at varying stages of lactation. On May 20 the order of milking the squads was reversed, so that in Squad X the milking intervals were 7 and 17 hours, and in Squad Z 11 and 13 hours approximately, Squad Y remaining the same as a control.

TABLE VI.

Period	Milking Intervals.	Morning Milk.	Evening Milk.
		Per Cent. Fat.	Per Cent. Fat.
X Squad { 1st week	9 and 15 hours	3·22	4·19
X Squad { 2nd week	7 and 17 hours	3·09	4·44
Y Squad { 1st week	9 and 15 hours	3·02	4·19
Y Squad { 2nd week	9 and 15 hours	3·02	4·14
Z Squad { 1st week	9 and 15 hours	3·09	4·34
Z Squad { 2nd week	11 and 13 hours	3·03	3·79

The changes brought about by the alteration in milking hours are in the direction of what we should expect, with the exception of the morning's milk of Squad Z, which remained low, notwithstanding the equalisation of the milking intervals. This may indicate that some other factor was at work in causing the morning's milk to be so low, but possibly a week may have been too short for the cows to accustom themselves to the changed conditions.

I think that fresh light can be thrown on these and other milk records by a study of the so-called "frequency" curves. If a number of results, which vary normally about a mean value, are plotted out so as to show the percentage of results falling at the various milk-fat percentages, a frequency curve is obtained of the general type shown in the dotted lines in the figures. The greatest number of samples cluster round the mean and on both sides of it, the number showing variation from the mean becoming progressively smaller as the extent of the variation increases. It is obvious that the greater the "dispersion" of the results—that is, the more variable they are—the flatter will be the curve.

It does not by any means follow that all series of experimental results conform to the normal law of variation and give a regular and symmetrical curve; in fact, the curves resulting from most measurements of naturally occurring variations show what is termed a definite degree of "skewness"—that is to say, the "mode," or point at which the greatest number of results fall, is shifted more or less to one side of the mean.

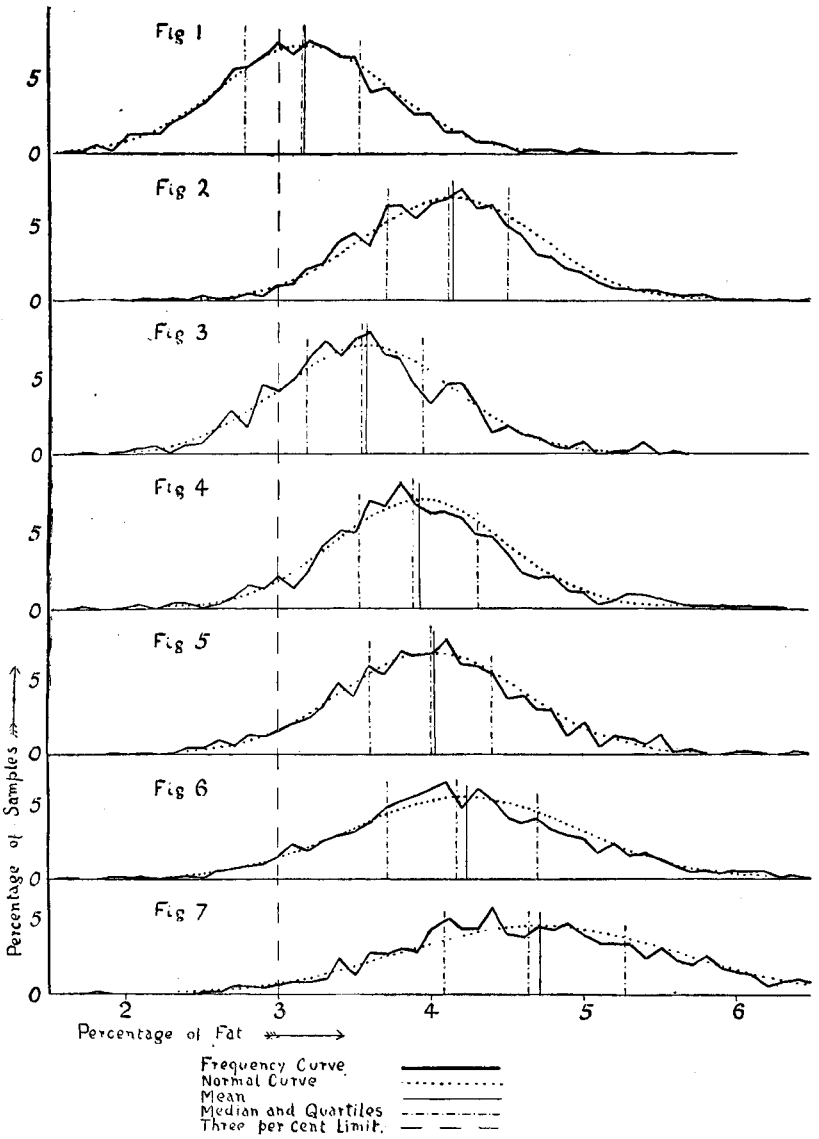
A normal frequency curve is characterised by the so-called "probable error," or, to use a term more suited to the present purpose, the "probable variation." This may be roughly defined as that degree of variation from the mean which includes 25 per cent. of the results on either side, or 50 per cent. in all.

The "probable variation" is, therefore, a simple way of expressing numerically the relative dispersion of all the results.

Several other terms have been introduced into the nomenclature of frequency curves, such as "coefficient of variability," "standard deviation," etc., but as these are mostly derived mathematically by means of the method of least squares, it is perhaps clearer and simpler to refer only to the "probable variation." In all these curves the "probable variation" has been ascertained as follows :

The exact positions of the "median," or middle point, of all the results and of the "quartiles," or quarter and three-quarter points, have been ascertained by arranging the results in groups and by interpolation. The group interval in each case is 0.1 per cent. of fat. The distance between the two quartiles, represented by the vertical dot and dash lines in the diagrams, may be termed the "50 per cent. zone." Half of this is taken as the "probable variation."

For the value thus obtained for the "probable variation" the normal curve has been drawn, using data which are to be found in mathematical tables. The normal curve is fitted to the results so that the "means" of the two curves coincide. It is useful to give these details, as there is more than one method of arriving at the probable error or probable variation, and also of fitting the normal curve to the frequency curve.



EXPLANATION OF CURVES.

FIG. 1.—Moundsmere herd morning milk from April 18 to May 26, 1915. 2,414 samples from single cows. Probable variation, 0·380.

FIG. 2.—Moundsmere herd evening milk. 2,411 samples from single cows. Probable variation, 0·396.

FIG. 3.—Lanark morning milk. 754 samples from single cows. Probable variation, 0·380.

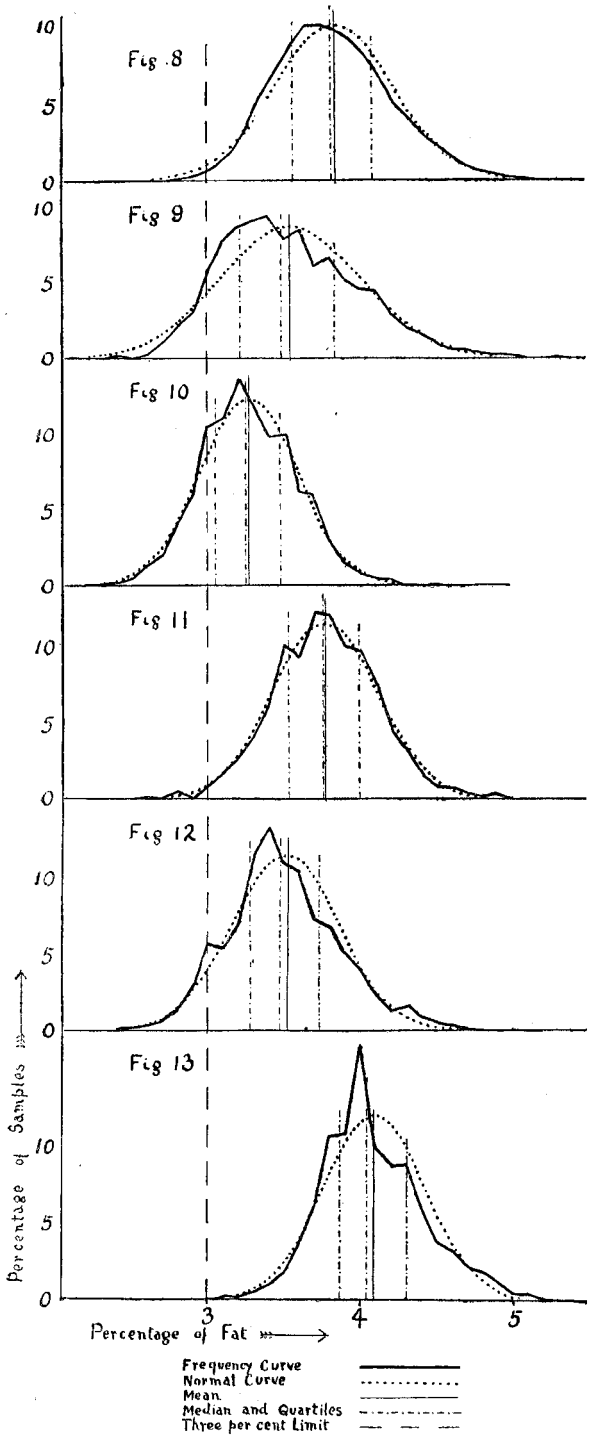


FIG. 4.—Lanark evening milk. 757 samples from single cows. Probable variation, 0·382.

FIG. 5.—1,292 samples from pedigree Shorthorns. Richmond: Committee on Milk and Cream Regulations, 1901, Appendix XXIV. Probable variation, 0·399.

FIG. 6.—2,549 samples from dairy Shorthorns. Richmond: Committee on Milk and Cream Regulations, 1902, Appendix XXIV. Probable variation, 0·493.

FIG. 7.—1,493 samples from Kerry cows. Richmond: Committee on Milk and Cream Regulations, 1901, Appendix XXIV. Probable variation, 0·599.

FIG. 8.—76,058 mixed milk samples as received by Aylesbury Dairy Company from 1894–99. Richmond: Committee on Milk and Cream Regulations, 1901, Appendix XXV. Probable variation, 0·267.

FIG. 9.—Dairy Company "A." 5,600 mixed milk churn samples, morning and evening, over period October 1, 1912, to June 30, 1913. Probable variation, 0·314.

FIG. 10.—Dairy Company "C." 1,499 samples of mixed morning milk from churns. One year period. Probable variation, 0·216.

FIG. 11.—Dairy Company "C." 1,417 samples of mixed evening milk from churns. One year period. Probable variation, 0·231.

FIG. 12.—Dairy Company "B." 4,377 samples of mixed morning milk from churns. One year period. Probable variation, 0·233.

FIG. 13.—Dairy Company "B." 2,460 samples of mixed evening milk from churns. One year period. Probable variation, 0·222.

It will be seen that where the milk of single cows is concerned, the correspondence with the normal curve is quite marked. Naturally, the greater the number of samples, the smoother the curve. The results obtained at Lanark, and published by Dr. Wilson, Medical Officer of Health for Lanark in 1913, comprised 1,511 samples equally divided between morning and evening. The total number of cows was 118, comprised in four separate herds at different farms. The samples were taken over short periods of three to four days each during November and December, and in one case fortnightly sampling was carried out as well. Great pains were taken to make the milking intervals as even as possible. The conditions were therefore very different to those obtaining in the case of the Moundsmere herd results, and there was plenty of opportunity for the intervention of factors which might make the variation abnormal. Allowing for the difference in the means, the distribution is seen to be remarkably similar to that of the Moundsmere results. The other frequency curves for the milk of single cows are drawn from Richmond's results published in the Report of the Milk and Cream Regulations Committee, 1901.

Mr. Richmond informs me that these results were obtained from the Aylesbury Dairy Company herds at Horsham, samples being taken at intervals extending over many months. The analyses were carried out by Dr. Vieth. Both morning and evening milk of the same day are included in these series, which is probably the reason why the relative dispersion is so high in two of them. The greater the difference between morning and evening milk the higher, of course, will be the dispersion if all the results are taken together.

It is noticeable that in some of these curves for single cow milks a certain degree of skewness is evident—that is to say, the point of maximum density of the results falls more or less to the left of the mean. This may be due to some extent to the way in which the curves have been fitted to each other, but is more probably an example of the slight asymmetry which is found to characterise many series of physiological variations.

No general rule can be formulated from so few instances, but the similarity of the Moundsmere and Lanark curves leads one to suspect that if sufficient samples are taken from corresponding milkings of a fair number of cows at one farm over a short period, the fat percentages will be found to follow approximately the law of normal variation, with a probable error of about 0·38 or 0·39.

When we come to the consideration of the frequency curves for mixed milk samples, it is evident that in several cases a greater degree of skewness is met with (*cf.* Richmond, ANALYST, 1904, **29**, 180, and Arup, Huish and Richmond, *ibid.*, 1917, **42**, 118). The records were kindly placed at my disposal by several large dairy companies, and, as far as I have been able to ascertain, comprise only genuine milks as received from the farms in churns. The normal curve for the probable variation in each case is shown by the dotted line. The left-hand branch of the curve is, in most cases, appreciably steeper than the right-hand branch. This is especially pronounced in Fig. 9.

This asymmetry may be partly explained by reference to the figures for fat percentage and milk yield in Table I. If we have a number of cows in varying stages of the lactation period, such as will ordinarily be found in a herd, the milk fat varies

very roughly in inverse proportion to the yield; but, as lactation progresses, the yields fall off much more rapidly than the milk fat increases. If therefore the samples are mixed at random, as would be done commercially in the filling of churns, the samples low in fat will, by reason of their relatively large bulk, exercise a preponderating influence upon the final series of mixed milk samples, and the result will be that an undue proportion of samples will fall just below the mean. In the case of the evening milks this relation between milk fat and yield is not so pronounced, so that there should not be the same tendency for the frequency curve of the mixed milk samples to assume an unsymmetrical form. This may be a partial explanation of the differences observed by Richmond between the curves for morning and evening milk, in addition, possibly, to the one suggested by him of a fortuitous admixture of morning and evening churns in one consignment. The relationship between morning and evening curves seems, however, to be somewhat erratic. Thus in Figs. 12 and 13 the asymmetry is, if anything, greater in the evening than in the morning milk, while in Fig. 9, where morning and evening samples are taken together, it is very pronounced.

An actual numerical expression of the degree of skewness or asymmetry is given by the expression

$$\frac{\text{Mean—middle point}}{\text{Probable variation.}}$$

The values of this expression for all the series of milk records dealt with in this paper are as follows, arranged in descending order:

Mixed Milk.	Single Cow Milks.	Degree of Skewness.
Dairy Company—"B" evening ...		0·234
Dairy Company—"B" morning ...		0·167
Dairy Company—"A" all samples		0·159
	[Richmond—dairy Shorthorns ...	0·146]
	[Richmond—Kerrys	0·128]
	Lanark—evening milk	0·105
Richmond: Milk Committee, 1901		0·094
Dairy Company—"C" morning ...		0·092
	Moundsmere—evening milks ...	0·081
	Lanark—morning milks	0·079
	Richmond — pedigree Shorthorns	0·043
	Moundsmere—morning milks ...	0·026
Dairy Company—"C" evening ...		0·022

Although there are several irregularities here, it is evident that there is a definite tendency for mixed milk samples to show a greater degree of skewness in the frequency curve than is the case with single cow samples. This tendency becomes still more marked if we neglect the Kerry and dairy Shorthorn series given by Richmond, which show what may perhaps be regarded as an abnormally high

degree of dispersion. It is noticeable that the asymmetry lies in every case in the same direction—*i.e.*, the middle point is always lower than the mean.

The small number of the series dealt with above, and the fact that the single cow series refer for the most part to short periods and individual farms, while the mixed milk series cover the whole year and are drawn from many farms, render the comparison uncertain. To establish definitely the extent to which varying yield affects the distribution of fat in series of mixed milk samples would require further series of records taken under more comparable conditions.

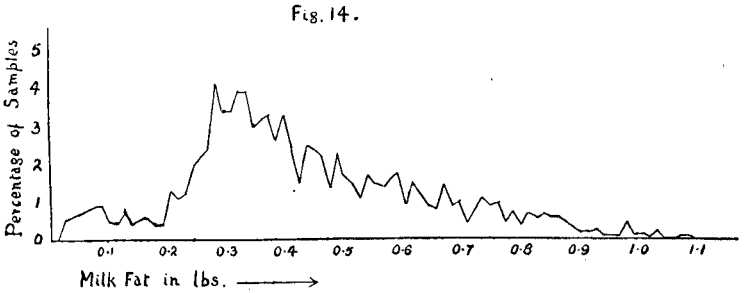
The asymmetry of these curves is of interest from the point of view of the present presumptive limit for milk fat. Thus, the Aylesbury Dairy records for 1900 to 1912 show that the average fat content for May and June was 3·31 per cent. and 3·28 per cent. respectively. At the same time the average number of samples falling below 3 per cent. was quite small, as shown in Table VII., where the figures show the actual percentage of samples falling at different fat percentages in May and June. If it were not for the skewness of the frequency curve, and the consequent steepness of the left-hand branch, the number of samples falling below 3 per cent. would be much greater.

TABLE VII.—AYLESBURY DAIRY AVERAGES, 1900-1912.

	Below 2·7 per Cent. Fat.	2·7 to 2·8 per Cent. Fat.	2·8 to 2·9 per Cent. Fat.	2·9 to 3 per Cent. Fat.	Total below 3 per Cent. Fat.
May	0·24	0·68	1·76	3·33	6·01
June	0·19	0·54	1·48	3·78	5·98

It is, perhaps, of interest to note that the figures in Table VII. increase very roughly in geometrical progression. Assuming this rate of increase to hold good approximately both for Aylesbury Dairy milk and for the mixed morning milk of the Moundsmere herd, the probability is that the latter, with the mean standing

Fig. 14.



at 3·08 per cent., if mixed in churns in the ordinary way, would have shown something like 25 per cent. of mixed milk samples below 3 per cent. of fat. This, of course, is only a very rough estimate.

In Fig. 14 is shown the frequency curve of the actual yield of milk-fat in the

morning's milk of individual cows of the Moundsmere herd for the period April 18 to May 26, 1915. This shows to a remarkable degree the combined effect of quality and quantity. It is seen that the weight of milk-fat yielded by a cow at one milking is very seldom less than 0·25 pound, but that the limit towards the upper end of the scale is not nearly so sharp. The "mode," or point at which the greatest density of results occurs, lies far to the left of the mean.

Discussion.

The President (Mr. Smetham) said that in 1891 and 1892 he carried out a series of investigations into Cheshire cheese-making at the Worleston Dairy Institute under the auspices of the Board of Agriculture. The herd, which consisted of thirty Shorthorns, was arranged to calve about the same time. In the course of the investigation not only were average samples taken of the night and morning milk, but also a considerable number of single samples were also taken and analysed, and observations of temperature and other meteorological conditions were duly registered, to see to what extent alterations in conditions affected the milk, and, incidentally, the quality and quantity of cheese. The milk gradually decreased from the time the experiment was started till the middle of October, when the experiment ceased. Generally speaking, the flow of milk fell off towards the end of the period, but the quality of the milk, particularly with regard to fat content, improved very considerably. When a period of cold weather set in, the quality of the milk was very seriously affected, and similarly the quality and quantity of the cheese. From his own experience he found that his results were in the main in accordance with the results given by Dr. Monier-Williams. Referring to the series of figures given in Richmond's records, he said that the gradual elimination of the poorest supplies would probably affect to some extent the averages.

Captain J. Golding was of opinion that the title of the paper might lead to some misunderstanding in dairying circles, where the term "milk records" was reserved for a catalogue of the performance of individual cows as to quantity of milk yielded, and did not always include the fat content. He did not think the percentages of fat in the milk of recently calved cows (Group 1) were remarkably low, having in view the times of milking. It was by no means unusual to find similar results on testing the milk of individual cows milked at similar intervals. Uniformity in the composition of this important foodstuff was, he thought, unattainable without undesirable artificial sophistication. The natural product from different breeds and from herds milked at different times could not be uniform in composition, and, like other goods of varying quality, could only be controlled by a guarantee given by the seller, who should be able to obtain a varying price according to quality.

Mr. Hawkins pointed out that it was sometimes alleged by the defence in cases of deficiency of fat that the turning out to grass was the main cause of such deficiency, but the figures recorded by Dr. Monier-Williams did not appear to support any such contention.

Mr. H. Droop Richmond wrote: By the courtesy of Dr. Monier-Williams I have been enabled to study his paper on Milk Records, and as a previous worker on the subject have found it of great interest and value. Mention is made of some

results which, though attributed to me, are really the work of Vieth, the analysis of all the milk of single cows having been carried out by him, and it is only the circumstance that I presented the records to the Milk Standards Committee as representative of the Aylesbury Dairy Company that has led to their being associated with my name. All the single cows belonged to the herds of the Aylesbury Dairy Company at Horsham, and samples were taken at intervals extending over many months, both morning and evening milk of the same day being analysed. The analyses were made by determining total solids and sp. gr., and calculating the fat by the formula devised by myself, Dr. Vieth being responsible for the analysis and I for the calculations.

I am not quite in agreement with Dr. Monier-Williams in his deductions from the Aylesbury Dairy figures given in Table VII., which are means of thirteen years' observation, and are derived from a total of nearly 10,000 analyses in each month, a number probably sufficient to give fairly accurate data. He says: "if it were not for the skewness of the frequency curve and the consequent steepness of the left-hand branch, the number of the samples falling below 3·0 per cent. would be much greater."

I have calculated by the theory of probabilities what the figures should be, and found that the observed and calculated figures are in remarkably close agreement, being—

	May.		June.	
	Observed. Per Cent.	Calculated. Per Cent.	Observed. Per Cent.	Calculated. Per Cent.
2·9–3·0	3·33	3·40	3·78	3·53
2·8–2·9	1·76	1·48	1·48	1·48
2·7–2·8	0·68	0·72	0·54	0·54
Below 2·7	0·24	0·28	0·19	0·19

The most interesting point brought out in the paper is the skewness of the curves, a point which is not fully elucidated; it has been overlooked that skewness of the curves necessarily follows, firstly, if the results can be arranged in a limited number of series, having different means and probable variations, and tends to disappear as the number of series multiplies; secondly, if the value of the interval taken varies progressively; and thirdly, if there is a disturbing cause which does not affect different results to the same degree—a condition which is not very different from the second.

All these conditions operate in milk records; I have shown (ANALYST, 1904, **29**, 180) that the skewness of the curve for six years' records (*cf.* table on p. 212, where it is referred to as Richmond: Milk Committee, 1901) is practically removed by splitting it up into two equal series representing morning and evening milks respectively, and later, in conjunction with Arup and Huish (*ibid.*, 1917, **42**, 118), that the skewness of the morning milk curve for 1914 can be eliminated by splitting it up into two series, one greater than the other, the evening curve showing no appreciable skewness.

The second condition is due to the Gerber results being slightly low with high fats, owing to the fact that an 11 c.c. pipette delivers less of a rich milk than a poor milk (ANALYST, 1905, **30**, 326; *cf.*, Day and Grimes, *ibid.*, 1918, **43**, 124); the difference is not enough to affect individual determinations, but, as the effect is cumulative, it will have a slight effect in skewing the curve on the right-hand branch.

The third condition appears in sampling errors owing to cream rising, and may best be illustrated by mentioning that, while the minimum amount of fat in milk cannot be as low as 0, the maximum may be very much more removed from the mean; if sampling errors were absolutely fortuitous the high results would be higher in proportion than the low. It is probable, however, that more samples are taken from near the surface of milk than from near the bottom, and if the milk is not uniform the proportion of high samples will tend to be greater than that of the low. This fact, while not affecting appreciably the mean value, will tend to skew the curve appreciably on the low side.

I do not think that the fat percentage and milk yield will have any appreciable effect on the asymmetry if a sufficiently large number of results be taken, though it will undoubtedly in a small series; the whole theory of probabilities, and the calculation of probable error and dispersion of results, is based on the assumption that the variations are affected by fortuitous circumstances, and that there is no constant circumstance affecting some results more than others; in a large series milk yields and fat percentages will tend to vary independently and not go together.

Asymmetry is due to the conditions affecting different series of results to a different extent, such as the conditions mentioned above, as well as also variation due to breed, feeding, times of milking, etc., on different farms, and to the number of series differently affected not being sufficient for the conditions affecting them to approximate to fortuity.

I would mention that variations in conditions affect the mean $\left(\frac{\Sigma(v)}{n}\right)$ least, the probable variation $0{\cdot}6745\sqrt{\frac{\Sigma(v^2)}{n-1}}$ next, and the distribution $\frac{1}{\sqrt{\pi}}\left(\int e^{-\left(\frac{x}{r}\right)^2} d\frac{x}{r}\right)$ to the greatest extent; while the mean of a series is probably of a high order of accuracy, and the probable deviation a fairly exact figure, the distribution on which the asymmetry depends is too sensitive to conditions, which can often only be guessed at, to be of much importance.

Both Vieth and I have studied carefully the effect on the mean of our method of deducing our average percentage by averaging the morning and evening means; the proportion of morning to evening milk over a long series of years was found to be 100 to 85, and we have found that the difference between the true mean and the average of the means of the two meals is less than 0·01 per cent. We concluded that the varying quantities represented by each sample do not affect the mean of the fat in the samples to any appreciable extent. It is not correct to take the yield of the Aylesbury Dairy Company morning milk as 50 per cent. greater than that of the evening milk; the mean milking intervals were 13·2 and 10·8 hours, and in both Aylesbury Dairy Company and Moundsmere cases the yields and intervals corresponded approximately.

Dr. Monier-Williams, in reply, agreed that one of the main reasons for the occurrence of poor milk was unevenness in milking intervals. Milking hours depended upon labour, transport, and market requirements, and uneven intervals seemed to be in many cases unavoidable under the existing system. There was a great difference observable in the records from different farms supplying the same dairy company; some farmers appeared to be able to keep the supply up to a uniformly high level, while others in the same district were not so successful. Records of fat percentage in milk from the north and the south of England, taken over corresponding periods in the same year, were practically identical, which seemed to show that, in the long run, differences in climate had little if any effect on the fat content.

With regard to Captain Golding's remarks as to the low fat content of milk from newly calved cows, the figures given in Group 1 were the averages for twenty-four cows which had calved at periods varying from three-and a-half to fourteen weeks before the commencement of the experiments. They could not therefore be taken as referring only to newly calved cows.

There was certainly a fall in fat percentage when the cows were turned out to grass, but this was comparatively slight. It was generally accepted that variation in feeding, within ordinary limits, had very little effect on the quality of milk. The daily records of the Moundsmere herd did not show any sudden drop in fat content when the herd was put out to grass.

The points raised by Mr. Richmond called for careful consideration. He remarked that skewness necessarily resulted if the results could be arranged in a limited number of series having different means and probable variations, and tended to disappear as the number of series multiplied. But any series of results, however asymmetric, might be conceived as being divisible into several different "sub-series," each of which might show normal variation, but with the means and probable variations differing according as the original curve showed a greater or less degree of skewness. The division of a skew series in this way into two or more sub-series did not necessarily throw any light on the cause of the original skewness, unless some particular significance could be assigned to the sub-series—*e.g.*, unless they could be proved to represent morning or evening milk. He did not think one was justified in assuming that the sub-series were representative of morning or evening milk without actual experimental evidence to that effect.

The fact that a pipette delivered less of a rich milk than of a poor milk was, no doubt, a contributory cause of the skewness of the curves, but should affect all series to the same relative extent—that is, of course, where the results had been obtained by the Gerber method. He doubted whether it explained the tendency of mixed milk curves to be more asymmetric than those of single cow milks.

Sampling errors again would undoubtedly have some effect in skewing the curve, but this effect would lie in the opposite direction to that arising from pipette error, and would also operate to an equal extent in both mixed and single cow samples.

Mr. Richmond had maintained that, in a large series, milk yields and fat percentages would tend to vary independently and not go together. It was in accord with general experience that, as the cow's lactation period progressed, the milk fell off

in quantity, but became richer in fat. If this was true for a small series of results, it should be equally true for a large series, as it was a condition which, while it might not affect every cow, would affect a fairly constant proportion of cows however great the number taken. He agreed with Mr. Richmond that asymmetry was due to a variety of conditions affecting different series of results to a different extent, but was of opinion that the relationship between yield and fat content was in most cases a controlling factor in the skewness of mixed milk curves, as distinct from those derived from single cow samples.

The figures given by Mr. Richmond as showing the close agreement between observed and calculated results for the proportion of samples falling below 3 per cent. of fat were presumably calculated by means of the formula given by him (ANALYST, 1904, **29**, 180). This formula was calculated empirically for a skew curve. It was clear from an inspection of the curves in Fig. 8 that if the actual frequency curve was compared with the normal curve, the statement was substantially correct that it was the skewness of the former which accounted for so few samples falling below the limit.

The difference between the true mean and the average of the morning and evening means would, of course, depend both on the difference in fat content and the difference in yield. In the Moundsmere results the true mean was 3·48, and the average of the morning and evening means 3·59, a difference of 0·11.

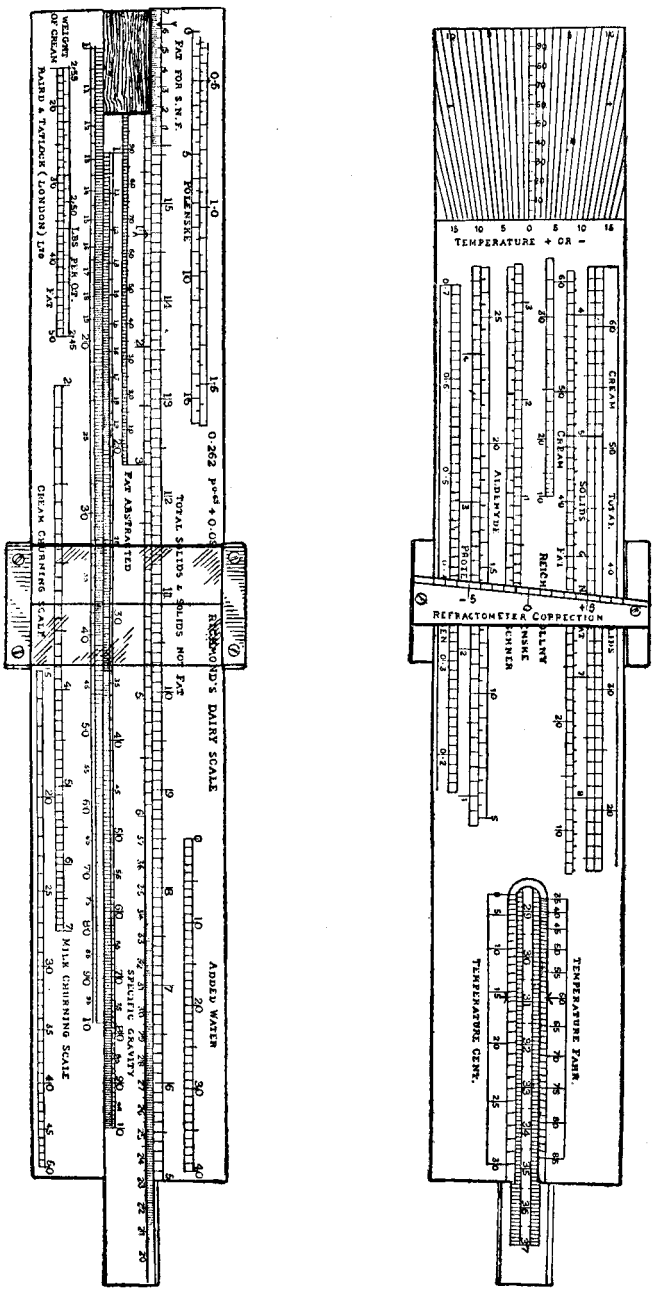
In seeking to ascertain the relative importance of the different conditions affecting the composition of milk, it was clearly preferable to study the distribution, which was the most sensitive to these conditions, rather than the mean, which was the characteristic least affected.

AN IMPROVED SLIDE RULE FOR DAIRY CALCULATIONS.

BY H. DROOP RICHMOND, F.I.C.

(*Read at the Meeting, April* 14, 1920.)

IN previous papers (ANALYST, 1888, **13**, 65; 1894, **19**, 38; 1898, **23**, 2) I have described the milk scale with various additions, and from time to time I have made other modifications to my own rule. As there are many calculations used in the analysis of milk and milk products, which may be combined in the same rule as the fat-total solid calculation for which the milk scale was designed, I have redrafted the scales on the rule, so that practically every calculation required in dairy analysis can be made with it. On the front of the rule, besides the original calculation of fat from total solids and sp. gr. of the milk scale, solids-not-fat can be deduced from fat and sp. gr., and "fat abstracted" and "added water" scales are also included; the latter reads not only from the solids-not-fat, but also (with an error of 1 in 69) from G + F (*cf. ibid.*, 1898, **23**, 69). For ease of reading, a cursor is included,



the celluloid form described by Stokes (ANALYST, 1894, **19**, 39) having been adopted. A scale connecting Polenske figures with $0{\cdot}262P^{0{\cdot}63} + 0{\cdot}09$ (*cf.* Bolton, Richmond and Revis. *ibid.*, 1912, **37**, 183) appears in the top left-hand corner.

A 10-inch logarithmic scale occupies the lower portion of the slide; in my experience this simple scale, without the scale of squares on the ordinary slide rule, suffices for practically all analytical calculations. Milk and cream churning scales, for calculating the amount of butter which can be produced from a given number of gallons of milk or quarts of cream of any percentage of fat, lie below the logarithmic scale and are used in conjunction with it. By means of the "weight of cream" scale adjacent, and by introducing the density of the milk, butter calculations can be made from pounds of cream or milk.

On the back of the scale at one end corrections of sp. gr. for temperature can be made, the temperature being given in both Fahrenheit and Centigrade degrees.

At the other end, butyro-refractometer readings can be corrected to a standard temperature by means of the fan-like scale and special cursor; this is modified from the chart previously published (ANALYST, 1907, **32**, 46). In the middle of the back, the mutual relations between total solids, fat, and solids-not-fat, in cream are expressed; lower down, the ratios between Reichert-Wollny and Polenske figures and Kirschner and Polenske figures (*ibid.*, 1919, **44**, 166) are given, and, at the bottom, aldehyde figures (*ibid.*, 1911, **36**, 9) may be converted into proteins and percentages of nitrogen and *vice versa*. The cursor may be reversed to aid the calculations on the back of the scale.

In all, it has been found possible to include some twenty scales, without making the rule unduly large, and, as one of them is a logarithmic scale, practically any calculation can be performed with ease and with an accuracy of three significant figures.

THE EXAMINATION OF CHINESE CRUDE CAMPHOR.

BY E. R. DOVEY, A.R.C.Sc., A.I.C.

(*Read at the Meeting, May* 5, 1920.)

IN the examination of crude camphor, the estimations usually required are those of non-volatile matter (or dirt), moisture, and oil, and the sum of these impurities subtracted from 100 per cent. is supposed to represent the camphor present. The moisture may be conveniently estimated by the calcium carbide method, allowing three hours for the evolution of gas, and the dirt by the residue left after volatilising a weighed portion of camphor.

So far as is known to the writer, no reliable method for the estimation of camphor oil in crude camphor has been published, other than the melting-point method given in Allen's "Commercial Organic Analysis," vol. iv., p. 197.

As this laboratory was called upon to examine a considerable number of Chinese crude camphors, the following method worked out here may be of interest: The moisture is first estimated on the well-mixed sample, then 100 grms., weighed to the nearest 0·1 grm., are transferred to a press and pressed between two layers of lint. The

press designed for this work has a steel cylinder 2 inches in diameter, and 6 inches deep, and is furnished with a movable perforated bottom plate. The piston is operated by a strong screw thread. The sample is allowed to remain in the press under pressure for fifteen minutes, at the end of which time it is carefully removed and the pressed cake weighed, any camphor adhering to the lint being carefully brushed off and added to the cake. From the loss in weight the amount of water plus oil expressed is found.

The moisture is then estimated on the pressed cake, and from the difference between the result and the original moisture the amount of water expressed is found, and, by difference, the amount of oil in the expressed liquid is found.

It is then assumed that the water still remaining in the pressed cake is associated with as much oil as that in the expressed liquid, and the total oil calculated on that basis. The accuracy of this assumption may be open to question, but, with a good press, very little moisture remains in the cake, while the m. pt. of the pressed camphor usually indicates a fairly high degree of purity.

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NOTE.

The Editor desires to point out that the pages of the Journal are open for the inclusion of short notes dealing with analytical practice and kindred matters. Such notes are submitted to the Publication Committee in the usual manner.

CORRECTIONS FOR DENSITIES OF ALCOHOL TO $\frac{15{\cdot}5^\circ\,C.}{15{\cdot}5^\circ\,C.}$

(Expansion of Glass Included.)

Temperature.		Specific Gravity read on Hydrometer or Westphal Balance.													
		0·99.	0·985.	0·98.	0·975.	0·97.	0·965.	0·96.	0·955.	0·95.	0·94.	0·93.	0·92.	0·9.	0·88.	0·85 to 0·79.
10	Subtract	0·6	0·75	1·2	1·7	2·25	2·85	3·15	3·35	3·7	3·9	4·1	4·15	4·35	4·45	4·6
11		0·5	0·65	1·0	1·35	1·85	2·3	2·6	2·75	3·05	3·2	3·35	3·45	3·6	3·65	3·8
12		0·4	0·5	0·8	1·05	1·45	1·8	2·0	2·15	2·35	2·5	2·6	2·7	2·8	2·85	2·95
13		0·3	0·35	0·55	0·75	1·0	1·3	1·45	1·55	1·7	1·8	1·9	1·95	2·0	2·05	2·15
14		0·15	0·2	0·35	0·45	0·6	0·75	0·85	0·95	1·05	1·1	1·15	1·2	1·25	1·25	1·3
15		0·05	0·05	0·1	0·1	0·2	0·25	0·3	0·35	0·35	0·4	0·4	0·45	0·45	0·45	0·45
16	Add	0·05	0·1	0·1	0·2	0·2	0·25	0·25	0·25	0·3	0·3	0·35	0·35	0·35	0·35	0·35
17		0·2	0·25	0·35	0·5	0·55	0·7	0·8	0·85	0·9	1·0	1·05	1·1	1·15	1·15	1·2
18		0·35	0·4	0·6	0·8	0·95	1·15	1·3	1·45	1·5	1·65	1·75	1·85	1·95	1·95	2·05
19		0·5	0·6	0·85	1·1	1·3	1·6	1·85	2·0	2·15	2·35	2·5	2·6	2·7	2·8	2·9
20		0·7	0·8	1·1	1·4	1·7	2·0	2·35	2·6	2·75	3·0	3·2	3·35	3·5	3·6	3·75
21		0·9	1·05	1·35	1·7	2·05	2·45	2·8	3·15	3·35	3·7	3·9	4·1	4·25	4·4	4·6
22		1·1	1·25	1·65	2·0	2·4	2·85	3·3	3·7	3·95	4·35	4·6	4·85	5·05	5·2	5·45
23		1·35	1·45	1·9	2·3	2·8	3·3	3·8	4·25	4·55	5·0	5·35	5·6	5·8	6·0	6·3
24		1·55	1·7	2·2	2·6	3·15	3·75	4·25	4·8	5·2	5·65	6·05	6·35	6·6	6·8	7·15
25		1·8	1·95	2·45	2·9	3·55	4·15	4·75	5·35	5·8	6·3	6·75	7·1	7·4	7·6	8·0

There is little new in this table, except the arrangement, the corrections being read from the specific gravity in air determined in a glass vessel, and the expansion of glass is included. The figures are based on Mendeleef's determinations, and it has been found that they agree essentially with later work, especially that of the U.S. Bureau of Standards. It is believed that by interpolation the specific gravity of any alcohol can be corrected to 15·5° with an error not exceeding 0·1° (0·0001 actual).

H. Droop Richmond.

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ABSTRACTS OF PAPERS PUBLISHED IN OTHER JOURNALS.

FOOD AND DRUGS ANALYSIS.

Acidimetry of Red Wines and Fruit Juices. A. M. Macmillan and A. Tingle. (*J. Ind. and Eng. Chem.*, 1920, **12**, 274-276.)—The use of litmus-paper for the titration of acidity in red wines is not very satisfactory, and the results are not comparable with those obtained with white wines when using phenolphthaleïn. The authors propose to use phenolphthaleïn also in the titration of red wines, and to determine the end point by spectroscopic means. Twenty-five c.c. of the wine or juice to be examined are introduced into the titration vessel with about 75 c.c. of water. $\frac{N}{10}$ sodium hydroxide solution is then rapidly added from a burette until the end point is near. This may be known either by the change in the natural colouring matter or by a previous rough titration. Phenolphthaleïn (2 c.c. of a 1 per cent. solution) is next added and the titration is continued with ordinary caution, the liquid being examined before a small spectroscope after each addition of alkali. The end point is shown by the sudden appearance of the absorption band characteristic of phenolphthaleïn. It lies in the green region of the spectrum very close to the yellow. The thickness of liquid suitable for observations at the dilution specified is 30 to 35 mm.; the liquid may be examined in flat 6-ounce bottles such as are used for retailing small quantities of whisky. The dilution of the sample before titration may be varied according to the depth of colour and the volume of standard alkali likely to be required in the titration. Sufficient water must be added to a highly coloured liquid to reduce the effective concentration of its colouring matter and sufficient indicator must be added to give an effective concentration showing the characteristic change. The region of the spectrum in which the absorption band due to the change of colour of the indicator is situated must not be obscured by absorption bands due to the original colouring matter of the liquid. J. F. B.

Boric Acid Modification of the Kjeldahl Method for the Analysis of Cereals and Soils. F. M. Scales and A. P. Harrison. (*J. Ind. and Eng. Chem.*, 1920, **12**, 350-352.)—Winkler's method of using boric acid instead of sulphuric acid for the fixation of the ammonia distilled in Kjeldahl's method (*Zeitsch. angew. Chem.*, 1913, **23**, 231) gives as accurate results as the older method, and has the advantage that the boric acid solution need only be measured approximately, only one standard solution (for titration) being required. Bromo-phenol blue is a more satisfactory indicator than either methyl orange or Congo red, which were used by Winkler. C. A. M.

Note on the Reichert-Meissl-Polenske Method. H. D. Richmond and G. F. Hall. (*J. Soc. Chem. Ind.*, 1920, **39**, 80T.)—The directions given by Polenske (ANALYST, 1904, **29**, 154) are frequently modified by varying the time required for the distillation, and cooling the distillate in water at 15° C. instead of the prescribed 10° C. Experimental determinations upon samples of coconut oil and butter fat

have shown that the time of distillation (from nineteen to thirty-eight minutes) does not make any material difference in the case of butter fat, but that with coconut oil it is essential to adhere to Polenske's directions (twenty-two minutes). On the other hand, the temperature to which the distillate is cooled (5° to 20° C.) does not have much influence on the result. C. A. M.

Double Polarisation Methods for the Determination of Cane Sugar. G. W. Rolfe and L. F. Hoyt. (*J. Ind. and Eng. Chem.*, 1920, **12**, 250-253.)—In the estimation of cane sugar by the Clerget method an error is caused by the difference in polarisation values in neutral solution for the direct polarisation, and in strongly acid solution for the invert reading. It is desirable, therefore, to make both readings in the presence of the same degree of acidity, but, if hydrochloric acid be employed, its inverting action in the cold is so rapid that accurate results cannot be obtained for the direct polarisation. The authors have investigated both trichloro- and monochloro-acetic acids and find that the latter acid may be employed as the basis of a satisfactory method. The normal weight of sample is dissolved in a 100 c.c. flask, the solution is clarified with an appropriate quantity of lead acetate, made up to 100 c.c. and filtered. Fifty c.c. of the filtrate are transferred to a 100 c.c. flask, 15 c.c. of a 20 per cent. solution of monochloro-acetic acid are added, and the volume is made up to 100 c.c. Direct polarisation must be made within fifteen minutes after adding the acid. For inversion, 50 c.c. of the liquid are placed in a 50 c.c. flask, the cork is tightly tied down and the flask is immersed in boiling water, maintaining active ebullition for thirty minutes, or for sixty minutes in the case of low-grade products clarified with a large amount of lead acetate. The flask is removed, cooled quickly to the temperature of the room, allowed to stand for at least two hours and polarised in the 200 mm. tube with thermometer. All solutions should be made up and polarised as nearly as possible at 20° C. The formula for cane sugar is $S = \frac{2(a-b)}{141 - \frac{t}{2}} \times 100$.

By this method both polarisations are made at the same acidity and sugar concentration. Excess of basic lead acetate equivalent to 0·5 c.c. in a half normal solution of sugar does not affect the inversion or produce troublesome precipitates. The results are more accurate than by the Herzfeld method, and approach more closely to those obtained by the standard invertase method. Inverted solutions of low grade products are lighter in colour than those inverted by the Herzfeld method and therefore easier to polarise, and the error introduced by the necessity of making up to volume after inversion is avoided. J. F. B.

Iodimetric Estimation of Sugars. H. M. Judd. (*Biochem. J.*, 1920, **14**, 255-262.)—When estimating the nature and amount of the carbohydrates found in apples during the process of ripening, in ordinary and cold storage, many difficulties are encountered when using the polarimeter. Since the optical activity of apple juice is very low, and the error involved in calculating the proportion of each of the sugars present from such small readings as 1° and less is very large, an investigation has been made into the quantitative estimation of sugars by means of iodine in

alkaline solution. In the main the results agree with those found by Willstätter and Schudel (ANALYST, 1918, **43**, 416), who state that there must be sufficient alkali to neutralise the acid formed as the result of the oxidation, and that the reaction goes best with decinormal solutions in the proportions required by the equation

$$CH_2OH[CHOH]_4.CHO + I_2 + 3NaOH = CH_2OH[CHOH]_4.COONa + 2NaI + 2H_2O.$$

They point out, however, that in the presence of free alkali the sugars undergo the Lobry de Bruyn transformation, also that cane sugar and lævulose are unacted upon. The present author has found, when working with pure sugars, that neither the method of Colin and Lièvin (*Bull. Soc. Chim.*, 1918, **47**, 403) nor that of Willstätter and Schudel is exact, and that in no case is the sugar oxidised quantitatively to the corresponding monobasic acid; on the other hand, there is always a small but definite attack on the lævulose. The results obtained with invert sugar are misleading, since the low result obtained from the dextrose is masked by the partial oxidation of the lævulose. Moreover, the reaction mixture always smells strongly of iodoform, showing that some secondary change is occurring. The chief source of error is probably the action of dilute alkalis on sugars, as investigated by Lobry de Bruyn and Van Ekenstein, part of the dextrose being converted into mannose, which is also oxidised by iodine, and part into lævulose. The whole of the sugar present would thus not be oxidisable by iodine, leading to a low result for dextrose, while lævulose itself would yield a certain proportion of both dextrose and mannose, thus probably accounting for the apparent partial oxidation of the lævulose. A complex but definite equilibrium is, however, reached, and it is possible to utilise the method for the analysis of mixtures of dextrose and lævulose, since experiments show that a given weight of dextrose always uses a definite and constant weight of iodine, although not the amount theoretically required, and this also holds true for levulose. It is thus possible to calculate from the iodine value and copper-reducing power of a mixture the proportion of each sugar present. The copper reduction method employed was that of Bertrand. For the oxidation by iodine the Willstätter and Schudel method was used as follows: 10 c.c. of an approximately 1 per cent. solution of dextrose is mixed with 20 c.c. $\frac{N}{10}$ iodine and 30 c.c. $\frac{N}{10}$ caustic soda, the mixture being allowed to stand fifteen to twenty minutes at room temperature. It is then acidified with dilute sulphuric acid and titrated with thiosulphate. One grm. of dextrose requires 1·315 grms. of iodine. The same volume of 1 per cent. lævulose solution, when treated with 10 c.c. of $\frac{N}{10}$ iodine and 20 c.c. of $\frac{N}{10}$ caustic soda, shows that 1 grm. of lævulose requires 0·1028 grm. of iodine. These constants, when combined with the cupric reducing power of the sugar, may then be used as follows:

2·369 = weight of CuO equivalent to 1 grm. of dextrose;
2·369 = weight of CuO equivalent to 1 grm. of lævulose;
1·315 = weight of iodine absorbed by 1 grm. of dextrose;
0·1028 = weight of iodine absorbed by 1 grm. of lævulose.
Let x = weight of dextrose in a given volume, V;
Let y = weight of levulose in a given volume, V;
Then $2{\cdot}369x + 2{\cdot}369y$ = weight of CuO corresponding to V;
$1{\cdot}315x + 0{\cdot}1028y$ = weight of iodine corresponding to V.

The solutions used were :

$\frac{N}{10}$ iodine ; 1 c.c. = 0·01293 I ;
$\frac{N}{10}$ thiosulphate ; 1 c.c. = 0·0128 I ;
$\frac{N}{10}$ $KMnO_4$; 1 c.c. = 0·06892 Cu.

Mixtures containing known amounts of dextrose and lævulose were analysed in the above manner, and results obtained of a high order of accuracy. The method has also been tried with other sugars with interesting results. The other hexose sugars behave in a manner similar to, but not identical with, dextrose. Each sugar appears to have its own characteristic iodine value, and mannose is oxidised with greater difficulty. Of the pentoses tested, arabinose takes up almost the theoretical amount of iodine, while rhamnose is oxidised much less completely. This may be associated with the fact that it does not, when oxidised, yield the very unstable rhamnonic acid, but a lactone. Remarkable results are obtained with the disaccharides. The action on saccharose is negligible. Maltose behaves quite normally, and the iodine value found by experiment agrees closely with that calculated from the equation

$$C_{11}H_{21}O_{10}CHO + I_2 = C_{11}H_{21}O_{10}COOH + 2HI.$$

Lactose, on the other hand, takes up twice as much iodine as is required by the equation, suggesting that the sugar is hydrolysed, and that both the dextrose and galactose molecules are then oxidised. H. F. E. H.

BACTERIOLOGICAL, PHYSIOLOGICAL, ETC.

Estimation of Chlorides in Whole Blood. J. H. Austin and D. Van Slyke. (*J. Biol. Chem.*, 1920, **41**, 345-348.)—The method of Van Slyke and Donleavy for the estimation of chlorides in plasma (*J. Biol. Chem.*, 1919, **37**, 551) yields results from 30 to 40 per cent. too high when used with whole blood. The following modification is employed, and gives results in agreement with those obtained by the Carius method : 3 c.c. of blood and 15 c.c. of water are measured into a 60 c.c. flask, 30 c.c. of saturated picric acid solution are added, the whole diluted to 60 c.c., mixed, left to stand ten minutes, and filtered. To 40 c.c. of the filtrate 10 c.c. of a solution containing 5·812 grms. of silver nitrate and 250 c.c. of nitric acid per litre are added, the solutions mixed and allowed to stand overnight. The supernatant liquid is filtered, 20 c.c. are titrated, and the result calculated, as in the Van Slyke-Donleavy method. This modification also yields accurate results with plasma coloured by the hæmolysis of the blood cells, and which gives abnormal results by the original unmodified method. T. J. W.

Determination of Fibrin, Globulin, and Albumin Nitrogen in Blood Plasma. G. E. Cullen and D. Van Slyke. (*J. Biol. Chem.*, 1920, **41**, 587-597.)—*Fibrin nitrogen :* To 5 c.c. of plasma from oxalated blood are added 150 c.c. of 0·8 per cent. sodium chloride and 5 c.c. of 2·5 per cent. calcium chloride, and allowed to stand fifteen minutes and filtered. The residue is washed five times with 0·8 per

cent. sodium chloride, allowing each portion to remain in contact with the fibrin for ten minutes; then transferred to a Kjeldahl flask, and the nitrogen determined. *Filtrate nitrogen:* 20 c.c. of water and 25 c.c. of saturated ammonium sulphate are added to 5 c.c. of plasma, allowed to stand overnight, and filtered. Twenty c.c. of the filtrate are transferred to a Kjeldahl flask, 300 c.c. of 50 per cent. alcohol, 3 grms. of magnesium oxide, and 1 c.c. of white mineral oil are added, and the whole distilled until the distillate gives a negative test with red litmus-paper. The residue in the flask is digested with sulphuric acid and potassium sulphate to a light brown colour, washed down with a few c.c. of water, 10 c.c. more of sulphuric acid added, and the digestion continued for about three hours. The nitrogen is then estimated as usual. *Non-protein nitrogen:* A 50 c.c. flask is half filled with 2·5 per cent. trichloracetic acid solution and 5 c.c. of plasma are added, the flask filled to the mark with trichloracetic acid solution, the contents mixed, allowed to stand one hour, and filtered. The filtrate is measured, transferred to a Kjeldahl flask, and the nitrogen determined as above. *Total plasma nitrogen:* This is determined by the Gunning-Kjeldahl method, using 2 c.c. of plasma and digesting three hours after clearing. Corrections for the reagents used should be made. Albumin nitrogen is calculated by deducting the non-protein nitrogen from the "filtrate nitrogen." Globulin nitrogen is determined by subtracting the sum of the "filtrate nitrogen" and the fibrin nitrogen from the total nitrogen. Descriptions are given of the working out of these methods, and the results obtained are tabulated. T. J. W.

Determination of Sugar in Blood. O. Folin and H. Wu. (*J. Biol. Chem.*, 1920, **41**, 367-374.)—A modification of the method previously described by the authors (*J. Biol. Chem.*, 1919, **38**, 106), in which the phenol reagent is replaced by one containing molybdic acid and sodium tungstate. Two standard solutions are employed containing respectively 1 and 2 mgrms. of dextrose or invert sugar per 10 c.c. These are prepared by dilution of a 1 per cent. stock solution preserved with xylene or toluene. Two c.c. of the tungstic acid blood filtrate are added to a special form of test-tube, and the same volume of the standard solutions to two similar tubes. To each tube 2 c.c. of an alkaline copper solution (prepared by dissolving 40 grms. of pure anhydrous sodium carbonate in about 400 c.c. of water, adding 7·5 grms. of tartaric acid, 4·5 grms. crystallised copper sulphate, and diluting to 1 litre) are added, and the tubes heated in a boiling water bath for six minutes, followed by rapid cooling in cold water without shaking. Two c.c. of the molybdate-tungstate reagent (35 grms. of molybdic acid and 5 grms. of sodium tungstate in 400 c.c. of 5 per cent. sodium hydroxide: the solution is boiled vigorously for about thirty minutes, cooled, diluted to about 350 c.c., and 125 c.c. of concentrated 85 per cent. phosphoric acid added, finally diluting to 500 c.c.) are run into each tube to dissolve the cuprous oxide; the volume is then made up to 25 c.c. with water, the contents of each tube mixed, and the blue colours compared. A special form of test-tube is described which reduces the oxidation of the precipitated cuprous oxide by the air, and tables are provided showing the effect of various factors upon the results. The new modification yields results slightly lower than those given by the original method.

T. J. W.

Estimation of Magnesium in Blood. W. Denis. (*J. Biol. Chem.*, 1920, **41**, 363-365.)—Five c.c. of citrated plasma, serum, or whole blood are run into 15 c.c. of 6·5 per cent. trichloracetic acid solution, shaken, allowed to stand at least thirty minutes, and filtered. Ten c.c. of the filtrate are used for the estimation of calcium by the method of Lyman (*J. Biol. Chem.*, 1917, **29**, 169), and the supernatant liquid and washings are transferred to a platinum dish, 3 c.c. of 10 per cent. sulphuric acid added, evaporated to dryness, and ignited until white. The residue is dissolved in about 5 c.c. of water, and 10 per cent. hydrochloric acid added drop by drop until the solution is acid to methyl orange. The solution is transferred to a beaker, evaporated to 2 or 3 c.c., concentrated ammonia is gradually added until the solution is alkaline and 0·5 c.c. of 10 per cent. ammonium phosphate solution containing 50 c.c. of concentrated ammonia per litre, the mixture then being allowed to stand overnight. It is then transferred to a conical centrifuge tube, and the beaker washed with 20 per cent. alcohol containing 50 c.c. of ammonia per litre. After centrifuging, the liquid is removed and the beaker again washed with about 10 c.c. of the alcohol-ammonia mixture, this being repeated three times. After removing the last portion of washing liquid the tube is placed upon a water-bath until the ammonia present has evaporated, and the precipitate is dissolved in 10 c.c. of $\frac{N}{10}$ hydrochloric acid, transferred to a 100 c.c. flask, diluted to that volume with water, and mixed. Twenty-five c.c. of this solution are diluted to 50 c.c., 25 c.c. of strychnine molybdate reagent (see Bloor, *J. Biol. Chem.*, 1911, **32**, 34) are added, and, after standing five minutes, the volume of suspension is compared with that produced by 0·01 mgrm. of magnesium in 50 c.c. to which 26 c.c. of the strychnine molybdate solution is added, and which has been allowed to stand for the same time as the unknown. Estimations made by the above method with aqueous solutions, plasma, and serum containing from 0·02 to 0·1 mgrm. of magnesium, give an average recovery of 94 per cent. Estimations made on human blood serum, including pathological cases, give figures varying from 0·8 to 3·8 mgrm. per 100 c.c., and on normal serum from 1·6 to 3·5 mgrms. T. J. W.

Separation of Hydrocarbons by the Aid of Bacteria. J. Tausz and M. Peter. (*Zentralbl. f. Bakter. u. Parasitenk.*, 1919, **49**, 497-554; *Chem. Zentralbl.*, 1920, **91**, II., 264.)—Certain bacteria which attack naphthenes but not paraffins furnish a means hitherto wanting of separating these bodies. *B. aliphaticum*, *B. aliphaticum liquefaciens*, and the paraffin bacterium, are described; these were grown from garden mould in inorganic or organic media to which *n*-hexane, cyclohexane, or paraffin oil had been added. Paraffin bacteria are without action on naphthenes, benzenoid hydrocarbons, and some paraffins—for example, *n*-hexane and *n*-octane—but attack higher paraffins such as hexadecane, triacontane, and tetracontane. The other two bacteria are inert towards cyclic hydrocarbons and hexylene, but attack paraffins and *n*-caprylene and hexadecylene. The destruction is complete, even in presence of inert hydrocarbons. The presence of a very small proportion of aliphatic hydrocarbon in natural naphthenes, or of impurity in artificially prepared specimens, is shown by the clouding, due to bacterial growth, of media to which the hydrocarbon has been added. Naphthenes thus treated possess higher

constants. The method can be used for the detection of paraffins in crude oils and their products, and for the isolation of pure naphthenes. None of the bacteria showed the presence of urease; diffusible lipase and proteolytic enzymes were recognised in *B. aliphaticum* and the paraffin bacterium, diastase in the paraffin bacterium and *B. aliphaticum*, and catalase in both species. The following new values were obtained: 1·3-dimethylcyclohexane, b.-pt. 118°-120° C., D 20° C./4° C. 0·771, $[n]_{D\ 20°\ C.}$ 1·4258; 1·3·4-trimethylcyclohexane, b.-pt. 139°-140° C., D 20° C./4° C. 0·789, $[n]_{D\ 20°\ C.}$ 1·4330. O. E. M.

Braunstein's Modification of the Mörner-Sjöqvist Process for the Estimation of Urea. A. H. Todd. (*Biochem. J.*, 1920, **14**, 252.)—Braunstein suggested the use of crystalline or syrupy phosphoric acid in place of sulphuric acid at the "Kjeldahl" stage of the Mörner-Sjöqvist process (in order to prevent hippuric acid and creatinine escaping precipitation and appearing in the final result as urea). This assumes that urea is completely incinerated under the Braunstein conditions, viz., heating at 145° C. for four and a half hours. The author finds that urea-estimation is by no means quantitative under the original conditions, and the temperature is the most important factor. Experiment showed that incineration of the Mörner-Sjöqvist filtrate for fourteen hours at 185° C. with 15 grms. of Kahlbaum's phosphoric acid gives an accurate quantitative estimation of the urea and of the urea only. With creatine and hippuric acid *per se*, no trace of incineration with phosphoric acid occurred when working under these conditions. The actual heating is best performed in an oil-bath, while phosphoric acid may most conveniently be weighed out by melting it in a water oven, and pouring it out into a weighed glass evaporating basin. H. F. E. H.

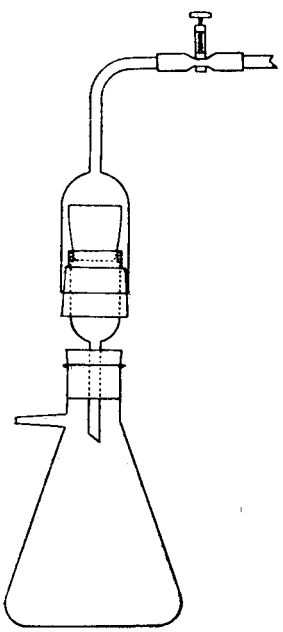
Titration of Organic Acids in Urine. D. Van Slyke and W. W. Palmer. (*J. Biol. Chem.*, 1920, **41**, 567-585.)—One hundred c.c. of urine are mixed with 2 grms. of finely divided calcium hydroxide, allowed to stand with occasional stirring about fifteen minutes and filtered. To 25 c.c. of the filtrate 0·5 c.c. of 1 per cent. phenolphthaleïn is added, and $\frac{N}{5}$ hydrochloric acid run in until the pink colour just disappears, when 5 c.c. of 0·02 per cent. tropæolin 00 solution are added with continual shaking, followed by $\frac{N}{5}$ hydrochloric acid which is added gradually from a burette until the colour equals that of a standard solution in a similar tube containing 0·6 c.c. of $\frac{N}{5}$ hydrochloric acid, 5 c.c. of tropæolin 00 solution, and water to a total volume of 60 c.c. In calculating the required result, a correction is first made by deducting the value obtained in a blank experiment, and finally by deducting the equivalent in organic acids of the creatinine present in the urine. A 0·1 M solution of creatinine is equivalent to a $\frac{N}{10}$ solution of organic acid. Other indicators, including methyl orange, tetrabromophenolsulphonephthaleïn and dimethylamino-azobenzene, may be used in place of tropæolin 00. The average 24-hour excretion of healthy adult males is 6 c.c. of $\frac{N}{10}$ acid per kilo of body weight. The theoretical basis of the method is discussed and numerous tables are provided showing results obtained by the above method with various acids, bases, and salts contained in urine, together with determinations made on normal and pathological urines. T. J. W.

ORGANIC ANALYSIS.

Estimation of Acetylene in Gaseous Mixtures. J. A. Muller. (*Bull. Soc. Chim.*, 1920, **27**, 69-71.)—The following method of estimating acetylene by precipitation as cuprous acetylide gives accurate results. From 70 to 80 c.c. of the gas containing not more than 10 to 11 c.c. of acetylene are shaken in a stoppered flask with an ammoniacal solution of cuprous chloride (1·2 to 1·3 grms. of 50 per cent. cuprous chloride, 6 c.c. of ammonia solution and 5 c.c. of water), until the acetylene is completely precipitated. The flask is then nearly filled with 10 per cent. sodium chloride solution, the liquid acidified with acetic acid, and the acetylide separated and washed. The filter and its contents are treated drop by drop with strong sulphuric acid until a homogeneous mass is obtained, and heated in a crucible (which is nearly covered) until acid fumes cease to be evolved, after which the temperature is raised to redness, so as to convert the whole of the copper into cupric oxide. The weight of the latter multiplied by 0·1407 gives the corresponding volume in c.c. of acetylene.

C. A. M.

Estimation of Cellulose in Woods. W. H. Dore. (*J. Ind. and Eng. Chem.*, 1920, **12**, 264-269.)—The estimation of cellulose in wood and similar vegetable tissues by the chlorination method may be made in two ways: with previous hydrolysis of the hemicellulose and furfural-yielding groups or without hydrolysis. In the former case the hydrolysis may be effected either by boiling with alkali, as in Cross and Bevan's method, or by acids at high temperatures, as in König's and Johnsen and Hovey's methods; chlorination without hydrolysis was originally recommended by Renker (ANALYST, 1910, **35**, 71), and has been adopted by several later investigators. There is a considerable difference in yield of cellulose estimated in these two ways, and the author has carried out experiments to ascertain whether the lower yield after previous hydrolysis is accounted for simply by the removal of carbohydrates inferior to cellulose, or is due to the destruction of the true cellulose. In these experiments 2 grms. of the wood, finely ground, were extracted, first with benzene and then with alcohol, for six hours each. The chlorination was performed in a Gooch crucible by the Seiber and Walter method in an apparatus illustrated in the accompanying figure, the sulphite treatment being conducted in the same crucible. The chlorine treatments, four in number, were carried out for twenty, fifteen, fifteen, and ten minutes respectively. The yields of cellulose corresponding to various pre-treatments were determined as follows: Renker's method (no hydrolysis), 48·51 per cent.; original Cross and Bevan's method (previous boiling with 1 per cent. sodium hydroxide for one hour), 45·83; Johnsen and Hovey's method (hydrolysis for



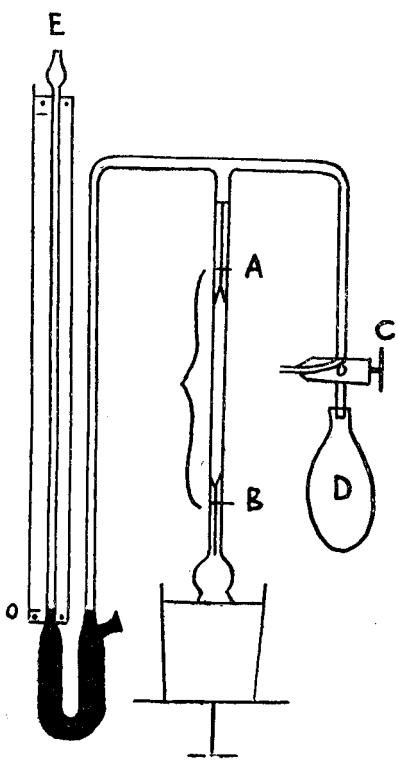
four hours with acetic acid and glycerol at 135° C.), 44·25. The ratio of α-cellulose to total cellulose in each of the products was determined by treatment with 17·5 per cent. sodium hydroxide, and showed 0·75, 0·77, 0·78, respectively. The yields of furfural were 0·50, 0·27, and 0·26 per cent. respectively. From these data it was concluded that the hydrolysis methods give substantially lower yields of cellulose than the direct chlorination method, and that the percentage of resistant α-cellulose is practically the same in all the products. Consequently the hydrolysis is not selective towards the inferior carbohydrates, but attacks the α-cellulose in the same ratio. Hence the Renker process, without special hydrolysis, is to be preferred since it gives the maximum yield of resistant cellulose. The above conclusion was confirmed by similar experiments on purified cotton cellulose, in which it was found that Renker's method gave about 4 per cent. more total cellulose than the hydrolysis methods, and that this cellulose was no less pure than the cellulose residue from the methods giving lower yields. It is considered that hemicelluloses and pentosans are hydrolysed and dissolved in the processes incidental to the direct chlorination method, and that special hydrolysis treatments are not only unnecessary, but detrimental to an accurate estimation of the true cellulose. J. F. B.

Detection of Ligneous Impurities in Cotton and Cotton Waste for Nitration Purposes. F. L. Barrett. (*J. Soc. Chem. Ind.*, 1920, **39**, 81-82T.)—The reaction is based on the strong affinity of lignin for basic dyestuffs, towards which it acts as a mordant similar to tannin. Malachite green is recommended for this purpose, and its fixation by the lignin is promoted by the addition of formaldehyde. After dyeing, the green dyestuff loosely held by the cotton fibres is discharged by a bleaching powder solution, to which the dyestuff fixed on the lignin is relatively resistant. The dye solution is prepared by dissolving 0·1 grm. of malachite green in water, diluting the solution to 500 c.c., adding 50 c.c. of 40 per cent. formaldehyde solution and 1 grm. of sodium bisulphate dissolved in a little water, and making up the whole to 1 litre. The bleaching powder solution is made by shaking 20 grms. of bleaching powder with 1 litre of water, allowing to settle and drawing off the clear liquor. In performing the test 300 c.c. of the dye solution are heated in a beaker in a boiling water bath, and 3 grms. of the cotton are steeped in the hot liquor for ten minutes. At the end of that time 25 c.c. of the bleach solution are added, and the liquid is stirred rapidly. The colour of the bath is immediately discharged, and the cotton is allowed to remain therein for a further five minutes. The liquor is then poured off through a funnel, using the cotton as a filter, and the material is rinsed thoroughly and examined, while wet, for the presence and distribution of green specks. It is important to use pure malachite green, and to keep the baths well stirred during dyeing and bleaching. J. F. B.

Distillation Method for the Analysis of Commercial Chlorobenzene. F. Bourion. (*Comptes rend.*, 1920, **170**, 933-935.)—Commercial chlorobenzene contains unchlorinated benzene and *p*-dichlorobenzene together with higher chlorinated compounds. The quantities of these impurities present, and that of the actual

monochlorobenzene, may be estimated by fractionally distilling 1,500 grms. of the sample, and collecting the fractions boiling between 80° and 130° C., 130° and 131·5° C., and 131·5° and 172° C. The first and third fractions are then refractionated (at 10° intervals of temperature) until further separation is impossible. The quantities of monochlorobenzene separated from these fractions are added to the main bulk of the monochlorobenzene (b.pt. 130° to 131·5° C.) after a portion of this has been carefully refractionated in order to ascertain the small amount of impurities still retained by it; unavoidable losses during the distillations are distributed proportionally among the various fractions. W. P. S.

Testing the Strength of Glue Jellies. W. H. Low. (*J. Ind. and Eng. Chem.*, 1920, **12**, 355-356.)—A modification of Smith's glue tester is described, in which some of the errors of the original instrument are obviated. Essentially it consists of a U-tube of the form shown in the diagram. This has a capillary attachment ending in a thistle funnel covered with a rubber membrane, and the pressure is applied by a rubber bulb, *D*. The U-tube is charged with mercury above which is a layer of coloured water, and an adjustable scale to indicate the pressure is fixed on the limb *E*. Sufficient water is introduced into the thistle funnel and capillary tube so that when a flat glass plate is held against the mouth of the former, the level of the water will be at the upper mark *A*, the three-way cock *C* being open to the air. This cock is then closed to the air, and opened to the rubber bulb and scale tube *E*, the water in which has been set at the zero mark. Steady pressure is applied to the bulb until the water in the capillary falls from *A* to *B*, and the level of the water in the scale tube is then read. In testing a glue jelly the vessel containing it is fixed so that the surface of the jelly is in contact with the rubber diaphragm, the pressure applied, and the readings taken as before. The difference between the pressure recorded and that previously required to overcome the resistance of the rubber diaphragm alone affords a measure of the consistency of the glue jelly. C. A. M.



Technical Methyl Chloroformates and their Analysis. M. Delépine. (*Bull. Soc. Chim.*, 1920, **27**, 39-45.)—For the estimation of formaldehyde and formic acid in technical methyl chloroformates it is best to determine the former by means of iodine, and then the formaldehyde and formic acid together by means of perman-

ganate, and to obtain the formic acid by difference. A weighed quantity (about 0·4 c.c.) of the sample is shaken in a closed vessel with 50 c.c. of $\frac{N}{1}$ sodium hydroxide solution, and, after 30 minutes, the liquid is made up to 125 c.c. The formaldehyde is estimated by adding 20 c.c. of $\frac{N}{10}$ iodine solution, drop by drop, to this solution with continual shaking, and then, after twenty minutes, adding 1 c.c. of dilute (1 : 5) sulphuric acid, and titrating the excess of iodine with standard thiosulphate solution. The formic acid is estimated by neutralising 25 c.c. of the solution with $\frac{N}{1}$ sulphuric acid (turmeric paper as indicator), then adding 5 c.c. of 10 per cent. sodium carbonate solution, and 50 c.c. of potassium permanganate solution (3·16 grms. per litre). After thirty minutes a measured quantity of oxalic acid solution (6·3 grms. per litre) is added (usually 40 c.c. is sufficient), and then 20 c.c. of the dilute sulphuric acid, and the clear solution titrated with the permanganate solution. In the case of each estimation, blank determinations are made with the same reagents in the absence of methyl chloroformate. The same solution of the sample is used for the estimation of the chlorine and carbon dioxide by the usual methods. Carbon monoxide is estimated by treating 0·3 to 0·5 grm. of the methyl chloroformate with 10 c.c. of 4N-potassium hydroxide solution in a mercury ureometer, and measuring the liberated gas. Methyl formate and chlorocarbonate do not evolve either carbon monoxide or formaldehyde. The results vary with the proportion of chlorine in the sample. Thus, German products containing 58·7 to 58·9 per cent. of chlorine evolved 80 and 73 c.c. of carbon monoxide respectively, whilst French products with 65·8 per cent. of chlorine yielded only 100 c.c. instead of 147 c.c. This is due to the fact that the chlorine in the course of the reactions forms further substitution products. C. A. M.

Determination of the Tensile Strength of Glue. G. Hopp. (*J. Ind. and Eng. Chem.*, 1920, **12**, 356-358.)—Solutions of glue of 60 to 80 per cent. by volume are made by soaking the glue for twelve hours, and then melting it up to a temperature of 160° F., care being taken to avoid frothing and air bubbles. The solutions are poured into polished iron moulds, 12 inches square and $\frac{1}{4}$ inch deep, and left to jell for about five hours. The resulting sheets are dried on suspended wire gauze, while protected from air currents, the final drying being effected under pressure. Strips about 7 inches long, 0·1 inch thick, and 0·33 inch wide, are then cut from these, and the centre portion (about 2·5 inches) ground on a grinding wheel. The strips are varied in thickness and width in order to check the results. The tensile strength of strips thus prepared is determined by means of a Schopper tensile machine. Samples of three different commercial glues thus examined gave the following average results: (1) 13·240 lbs.; (2) 8·523 lbs.; and (3) 11·573 lbs. per square inch. C. A. M.

Estimation of Trimethyleneglycol in Distilled Glycerol. C. A. Rojahn. (*Zeitsch. anal. Chem.*, 1919, **58**, 433-442.)—The quantity of trimethyleneglycol may be calculated from the sp. gr. and water content of the sample. Glycerol has a sp. gr. of 1·2653 at 15°/15° C., whilst that of the glycol is 1·0573. The sp. gr. of glycerol is diminished by the presence of the glycol or water, or both, but as the

quantity of water is known (by estimation), the percentage of the glycol is found by simple calculation. Tables and graphs are given in the original to facilitate the calculation. To estimate the water, about 2 grms. of the sample are placed on asbestos and dried for twenty-four to forty-eight hours over phosphorus pentoxide at a pressure of about 10 mm. W. P. S.

Detection of Methyl Alcohol in Spirits. P. Hasse. (*Pharm. Zentr.*, 1920, **61**, 177-182; through *J. Soc. Chem. Ind.*, 1920, **39**, 345 A.)—The sample is distilled and 0·5 c.c. of the distillate (containing not more than 0·025 c.c. of alcohol) is mixed with 1 c.c. of 5 per cent. potassium permanganate solution, 2·5 c.c. of dilute sulphuric acid (sulphuric acid, 19 grms., water 200 c.c.), and, after standing two minutes, the mixture is decolorised by the addition of 1 c.c. of 10 per cent. oxalic acid solution. To 0·5 c.c. of this mixture are then added 1 drop of peptone solution (= 2·5 mgrms. of peptone), and 1 c.c. of sulphuric acid containing iron (0·05 grm. of iron alum dissolved in 1 c.c. of water and added to 300 grms. of sulphuric acid). A deep blue colour is obtained if the spirit contained 1 per cent. of methyl alcohol; a red-blue colour is produced by 0·3 per cent. of the alcohol. Pure ethyl alcohol gives a yellowish-red coloration with the test. If an indication of the presence of methyl alcohol is obtained, it should be confirmed by the morphine and magenta-sulphurous acid tests.

Estimation of Mineral Constituents in Organic Substances, especially those containing Phosphorus. J. Grossfeld. (*Chem. Zeit.*, 1920, **44**, 285-286.)—Substances such as albumin, yolk of egg, blood, etc., can be burnt readily to a white ash if they are treated previously with magnesium acetate solution and dried. The whole of the phosphorus present in the substance is retained in the ash. The magnesium acetate solution is prepared by dissolving 50 grms. of magnesia in a slight excess of acetic acid and diluting the solution to 1 litre; 20 c.c. are sufficient for 5 grms. of organic substance. In the estimation of ash constituents an allowance must of course be made for the amount of magnesia added as acetate. W. P. S.

Volumetric Estimation of Nitro-Aromatic Derivatives. D. Florentin and H. Vandenberghe. (*Bull. Soc. Chim.*, 1920, **27**, 158-166.)—Contrary to various published statements, the reduction of nitrotoluenes by stannous chloride gives, in addition to pure toluidines, *p*-chlorotoluidines, owing to the transposition of hydroxylamines which are formed as intermediate products. Hence only two molecules of stannous chloride react instead of the three required by the normal reaction. For this reason the volumetric estimation of nitrotoluenes by means of stannous chloride never gives correct results, and is especially inaccurate in the case of *o*-nitrotoluene. Other nitro derivatives of benzene may be quantitatively estimated by titration with stannous chloride in the presence of hydrochloric acid. With the exception of *o*-nitrotoluene, titanous chloride reduces nitro derivatives of benzene quantitatively in accordance with the equation:

$$C_6H_5.NO_2 + 6TiCl_3 + 6HCl = C_6H_5.NH_2 + 6TiCl_4 + H_2O.$$

The reduction may be effected by heating 0·2 grm. of the nitro derivative with 10 c.c. of standardised titanous chloride solution in a sealed tube for two hours, and, after cooling, diluting the liquid to 100 c.c., shaking thoroughly, and running it from a burette into a known quantity of ferric sulphate solution, using thiocyanate as indicator. Polynitro derivatives may be titrated in an open flask in presence of a current of carbon dioxide. In the case of *o*-nitrotoluene the error does not exceed 3 per cent.

C. A. M.

Estimation of the Nitro Group in Aromatic Organic Compounds. T. Callan, J. A. R. Henderson, and N. Strafford. (*J. Soc. Chem. Ind.*, 1920, **39**, 86-88T.)—The usual method for the estimation of nitro groups in aromatic compounds is by reduction with titanous or stannous chloride and titration of the excess of reducing agent. The method of Knecht and Hibbert, using titanous chloride, gives accurate results in most cases, but certain substances, such as *o*-nitroanisole, nitrocresyl methyl ether, α-mononitronaphthalene, and others, only give about two-thirds of their theoretical value. This is particularly the case when the reduction is effected in the presence of alcohol. The authors show that the low results are due to the simultaneous chlorination of the aromatic compound, and that the nitro derivatives yield chlorinated amines. Nearly normal values are obtained if chlorination be impeded by previous sulphonation of the nitro compound, and the reaction is perfectly satisfactory if titanous sulphate be used for the reduction instead of titanous chloride. The only objection to titanous sulphate is its extreme sensitiveness to atmospheric oxidation at the boiling temperature. It is necessary, therefore, to boil the titanous sulphate solution in a flask provided with a two-holed stopper with narrow entrance and exit tubes for carbon dioxide, and to work with great care to prevent oxidation; the liquid is cooled in a stream of carbon dioxide, and may then be titrated with a standard solution of iron alum, no special precautions being necessary with the cold solution. The reducing agent is prepared by adding 400 c.c. of commercial titanous sulphate (about 12 per cent.) to about 500 c.c. of dilute sulphuric acid (1 in 4), boiling for a few minutes, cooling, and making up to 1,000 c.c. The use of stannous chloride as a reducing agent offers no advantages over that of titanous chloride, the tendency to chlorination being at least as great. A very useful method, though of limited application, consists in reducing the nitro compound and titrating the amine with nitrous acid. About $\frac{1}{20}$ grm. mol. of the nitro compound is dissolved or suspended in excess of dilute hydrochloric acid, and zinc dust is added gradually in considerable excess while the solution is warmed. After about half an hour the solution is filtered, diluted, cooled by the addition of ice, and titrated with $\frac{N}{2}$ sodium nitrite until a drop of the liquid on iodide-starch paper indicates an excess of nitrous acid. In this reaction the formation of chlorinated amines is immaterial provided the products of the reduction form diazo compounds with nitrous acid. It is important that the acid and the zinc dust be free from iron, or, alternatively, a blank determination must be made to ascertain the amount of nitrite consumed by reaction with the ferrous iron present.

J. F. B.

Estimation of Incompletely Nitrated Phenol in the Mother-Liquors of Melinite. Marqueyrol and P. Carré. (*Bull. Soc. Chim.*, 1920, **27**, 127-140.)—The volumetric estimation of incompletely nitrated phenol in the mother-liquors of melinite by means of bromine invariably gives too high results, the error varying with the composition of the sample and with the conditions of the nitration. This is due to the fact that the incompletely nitrated phenol is present in various forms which behave differently towards bromine. There are also always present two isomeric sodium dinitrophenol-sulphonates, and sometimes sodium mononitrophenol-sulphonates, each of which reacts differently with bromine according to the conditions of temperature, duration of contact, etc. Moreover, the bromine also reacts with the residual picric acid in the liquid. Results sufficiently accurate are obtained by completing the nitration of the mother-liquids and titrating the picric acid formed: 100 c.c. of the sample are concentrated until their b.-pt. reaches 125° C., and are then heated with 25 c.c. of nitric acid (62 per cent.) for fifteen to twenty minutes at 115° to 120° C., after which an additional 10 c.c. of acid are added, and the heating continued until the b.-pt. again reaches 120° to 125° C. The liquid is then diluted to 100 c.c. with cold water, and the picric acid separated with the aid of a filter pump, washed five times with 4 c.c. of water and titrated with $\frac{N}{10}$ sodium hydroxide solution with methyl red as indicator. A correction of 0·12 to 0·16 grm. (according to the amount of picric acid) is made for the solubility of the picric acid in the washing water. C. A. M.

Determination of Cellulose in Rubber Goods. S. W. Epstein and R. L. Moore. (*Indiarubber J.*, 1920, **59**, 559-566; through *J. Soc. Chem. Ind.*, 1920, **39**, 343A.)—One half grm. of the rubber is digested with 25 c.c. of freshly distilled cresol (b.-pt. 198° C.) for four hours at 160° to 185° C., then cooled and 200 c.c. of light petroleum spirit (b.-pt. 45° to 50° C.) added with constant agitation. After allowing to settle and decanting the liquid through a Gooch crucible containing a pad of acid-treated, ignited asbestos, the residue is washed thrice with petroleum spirit, five times with hot benzene, and once or twice with acetone; it is then treated with hot hydrochloric acid (10 per cent.), transferred completely to the crucible, washed ten times with hydrochloric acid, then with water until free from chlorides, and treated with acetone and subsequently with a mixture of acetone and carbon bisulphide (1 : 1) until the extracts are colourless. The residue is washed with alcohol, dried for ninety minutes at 105° C., transferred to a weighing bottle and weighed. The extracted material is digested in a beaker with 15 c.c. of acetic anhydride and 0·5 c.c. of sulphuric acid for thirty minutes at 75° C., cooled, treated with 25 c.c. of 90 per cent. acetic acid, filtered slowly through a pad of treated asbestos in a Gooch crucible, washed repeatedly with hot 90 per cent. acetic acid and then five times with acetone. The crucible is placed in a weighing bottle, dried for two hours at 150° C., and then weighed. The loss in weight on acetylation represents the cellulose. The presence of leather does not interfere with the method, but in such a case it is desirable to digest with cresol at 120° C. for sixteen hours. The acetylation process indicates 95 per cent. of any wood present, 90 per cent. of any jute, 21 per cent. of cork, and 70 per cent. of any leather.

INORGANIC ANALYSIS.

Use of Cupferron in Quantitative Analysis. G. E. F. Lundell and H. B. Knowles. (*J. Ind. and Eng. Chem.*, 1920, **12**, 344-350.)—From an experimental study of the method of estimating metals by precipitation with cupferron (the ammonium salt of nitrosophenylhydroxylamine) the following conclusions have been drawn: The reagent can be used for the accurate estimation of iron, copper, titanium, zirconium, thorium, and vanadium. In any given estimation the partial or complete precipitation of these metals must therefore be taken into consideration, whilst the following elements also interfere with the estimation of other metals: Lead, silver, mercury, tin, bismuth, cerium, thorium, tungsten, uranium in the quadrivalent condition, and vanadium; and in certain cases phosphorus, alkali salts, and alkaline earth compounds if present in excessive amounts. Hence the cupferron method is only applicable when the qualitative composition of the material is known. The reagent may be advantageously used for certain separations, such as iron from manganese, and titanium from aluminium and manganese. C. A. M.

Analysis of Iron Ore. E. Little and W. L. Hult. (*J. Ind. and Eng. Chem.*, 1920, **12**, 269-273.)—The use of dichromate as an oxidising agent instead of permanganate is recommended, particularly since it has no action on dilute hydrochloric acid. Up to now the principal objection has been the absence of a convenient indicator. Potassium iodide and starch may, however, be used, provided the influence of the ferric ion be inhibited by the introduction of ammonium fluoride. An excess of dichromate is used, and the liberated iodine is titrated back with thiosulphate. The weight of ore in the solution to be titrated should contain iron equivalent to about 25 c.c. of a $\frac{N}{10}$ solution. The ore should be dissolved in 20 to 35 c.c. of hydrochloric acid 1 : 1; an excess of acid produces an indefinite end point. The amount of potassium iodide should be 5 grms. For the reduction of the iron solution a slow passage through the Jones reductor gives the most satisfactory results; fairly good results can be obtained with stannous chloride using mercuric chloride to destroy the excess of the latter, but, with any appreciable excess of stannous chloride, difficulties are experienced owing to the reaction of the iodine with the calomel produced. The amount of ammonium fluoride used should be about 5 grms. The total volume after titration should be 250 to 350 c.c. J. F. B.

Volumetric Estimation of Manganese. P. Nicolardot, A. Reglade, and M. Geloso. (*Comptes rend.*, 1920, **170**, 808-810.)—In the estimation of manganese by Knorre's method (precipitating the manganese as dioxide by ammonium persulphate, dissolving the precipitate in excess of ferrous sulphate solution and titrating the excess with permanganate solution) the reaction proceeds according to the equation: $MnO_2 + 2FeO + 4H_2SO_4 = Fe_2(SO_4)_3 + MnSO_4 + 4H_2O$, and Fe should be equivalent to 0·4917 Mn. It is found in practice that a higher factor is required, and different workers have suggested values ranging from 0·392 to 0·501. The authors find that the presence of iron affects the composition of the manganese dioxide preci-

pitate. In the absence of iron, the factor is 0·498, whilst with 40 per cent. of iron (calculated on the manganese-iron mixture) the factor is 0·4929. Dilution is without influence on the results. W. P. S.

Estimation of Mercury by Gluckmann's Method. A. Abelmann. (*Zeitsch. anal. Chem.*, 1919, **58**, 443-445.)—Gluckmann's method for the estimation of mercury (precipitation with an excess of oxalic acid and subsequent titration of the excess with permanganate solution) yields untrustworthy results owing to the solubility of mercuric oxalate and to the formation of basic salts. The error due to solubility may be decreased by adding potassium nitrate, whilst the addition of a small quantity of nitric acid prevents the production of basic salts during the precipitation. The mercury salt solution is treated with 3 c.c. of 5N nitric acid and a large excess of oxalic acid, 50 c.c. of saturated potassium nitrate solution are then added, the mixture diluted to 100 c.c., filtered, and the excess of oxalic acid is titrated in the filtrate. When thus modified, the method yields from 98·6 to 100 per cent. of the mercury present. W. P. S.

Estimation of Potassium as Perchlorate. G. P. Baxter and M. Kobayashi. (*J. Amer. Chem. Soc.*, 1920, **42**, 735-742.)—When much sodium perchlorate is present with the potassium perchlorate, the sodium salt should be removed by washing with alcohol containing perchloric acid before the washing with alcohol saturated with potassium perchlorate is commenced (*cf.* ANALYST, 1917, **42**, 155). The authors agree with Gooch and Blake (*ibid.*, 1918, **43**, 277) that sodium perchlorate causes the precipitation of potassium perchlorate from the saturated alcoholic solution of the latter, particularly when in contact with solid potassium perchlorate. The washing should be carried out at 0° C. W. P. S.

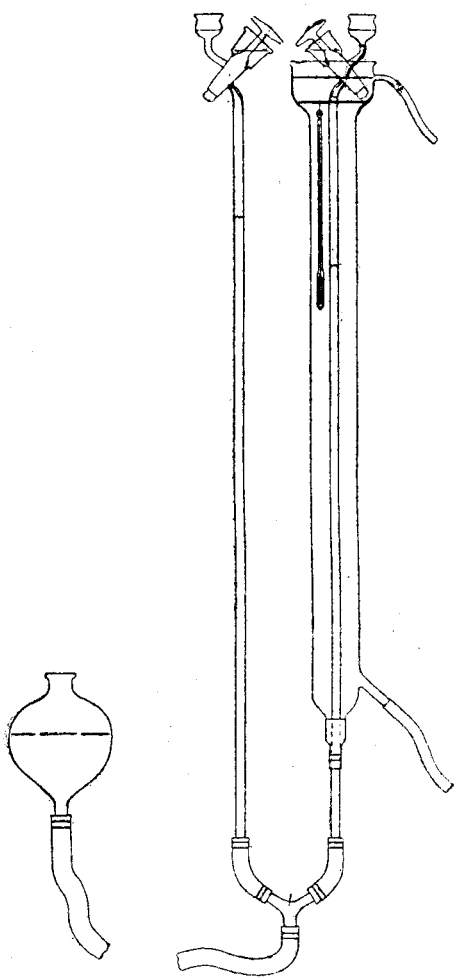
Reaction of Potassium Anhydrotellurate. P. Hulot. (*Bull. Soc. Chim.*, 1920, **27**, 33.)—On fusing tellurium, or tellurous acid or alkali tellurites with potassium nitrate, there is not complete conversion into potassium tellurate, but a white powder is left as a residue which is insoluble in water and in hot concentrated mineral acids. This product is potassium anhydrotellurate, $Te_4O_{13}K_2$. It may be reduced to metallic tellurium by suspending it in water containing a third of its volume of hydrochloric acid and adding a few fragments of zinc. The reaction is applicable to the treatment of tellurium ores, which may thus be decomposed by the wet method without loss of tellurium. C. A. M.

Potassium Chlorate as a Standardising Substance for Alkali Solutions. H. B. Van Valkenburgh. (*J. Amer. Chem. Soc.*, 1920, **42**, 757-760).—Potassium chlorate, recrystallised and dried for five hours at 240° C., may be used for standardising alkali solutions. A weighed portion of the dry salt is dissolved in water, the solution boiled for ten minutes, a current of sulphur dioxide is then passed into the boiling solution for thirty minutes, or until all the chlorate is reduced, the boiling continued for about five minutes, and the resulting sulphuric acid then titrated with the alkali solution, using phenolphthaleïn as indicator. The reaction is expressed by the equation: $KClO_3 + 3SO_2 + 3H_2O = 3H_2SO_4 + KCl$. W. P. S.

Potassium Hydrogen Phthalate as a Standard in Volumetric Analysis. W. S. Hendrixson. (*J. Amer. Chem. Soc.*, 1920, **42**, 724-727.)—Further experience with potassium hydrogen phthalate, recommended previously by the author (ANALYST, 1915, **40**, 509) as a standard substance for volumetric solutions, shows that the salt can be prepared readily from phthalic anhydride and a slight excess of potassium carbonate, and that, after two recrystallisations, it is pure enough for all practical purposes. The salt is free from water of crystallisation and is not hygroscopic.

W. P. S.

APPARATUS, ETC.



Instrument for Measuring Vapour Tension. H. Moore. (*J. Soc. Chem. Ind.*, 1920, **39**, 78-80T.)—The apparatus shown in the diagram has been primarily devised for determining the vapour tension and, consequently, the volatility of motor spirit. It consists of two tubes of about $\frac{1}{4}$ inch bore and about 800 mm. in length, connected with each other and with a levelling bulb by means of a Y-piece and thick-walled rubber tubing. The two tubes have cocks at the top sealed with mercury, and one of them is surrounded by a water-jacket in which a thermometer is suspended. In making a determination, mercury is introduced into the two cups attached to the cocks, which are opened while the levelling bulb is raised. The cocks are then closed, and the levelling bulb lowered, so that two barometer tubes are formed. One cup is filled with motor spirit, and a small amount, measured by a mark below the cock, is run into the tube, and sufficient mercury afterwards placed in the cup to form a seal. On lowering the levelling bulb the barometric height may be read on the empty tube, whilst the jacketed tube, containing the motor spirit, gives a reading which is the barometric height less the vapour pressure of the motor spirit at the temperature of the determination. The difference in the heights of mercury in the two tubes is the vapour-pressure reading. For accurate readings a correction for the density of the mercury is necessary, but in the case of the motor-spirit tests the amount is less than the normal experimental error.

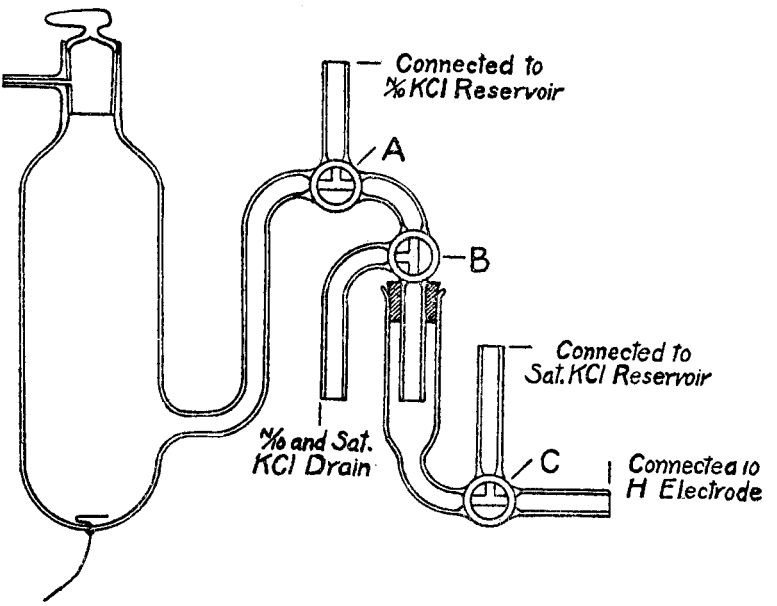
C. A. M.

Barger's Microscopical Method of determining Molecular Weights. Part I. Kumao Yamakami. (*J. Biol. Chem.*, 1920, **41**, 103-113.)—Barger's method for determining molecular weights (*J. Chem. Soc.*, 1904, **85**, 286) is stated by the author to be based upon vapour pressure. Series of drops, taken from two solutions, the one the standard, the other a given solution, of which the molecular weight of the solute is to be determined, are alternately introduced into a capillary tube, and the change in the length of the drops is studied by means of a micrometer. If one series of drops is observed to have increased while those alternating with them have decreased, it is to be assumed that the solution from which the former series of drops was taken has a higher molecular concentration than the latter. The given solution is thus compared with a series of standard solutions of known molecular concentrations, and in this way two limits are reached for the unknown molecular concentration. In a large number of experiments described by the author, he concludes that it is impossible to explain the reactions involved without assuming that the drop-change occurred because of a transference, not only of vapour, but also of liquid from the weaker solution through the film furnished by the liquid membrane which extended between the two drops. The author considers that he has proved that the force which effects the volume-change of the drops is not simply the vapour pressure, but also the osmosis through the thin film of liquid between the drops. If the length of the intervals between the drops is 2-3 mm., $\frac{5}{6}$ to $\frac{6}{7}$ of the volume-change of the drops is attributable to osmosis. Further, as osmosis as well as the lowering of vapour pressure are equally the results of one and the same internal energy of solution—that is, the molecular and ionic attraction of solute for solvent, which is of the same magnitude for all kinds of molecules and ions in the same solvent at the same temperature—it is possible to measure molecular weights or the same degree of association or dissociation by investigating the volume-change of drops which are brought in contact with drops of standard solutions of known molecular concentrations. H. F. E. H.

Colorimetric Determination of Titration Curves without Buffer Mixtures. L. J. Gillespie. (*J. Amer. Chem. Soc.*, 1920, **42**, 742-748.)—The hydrogen ion exponents are determined by the use of a colour standard consisting of a pair of test-tubes containing together 10 drops of indicator solution of suitable strength, the drop ratio being varied from 1 : 9 to 9 : 1. One of the tubes contains dilute alkali solution and the other dilute acid. Reference to a table gives the hydrogen ion exponent corresponding with the drop ratio, or the exponents can be calculated from the relation $P_H = k + \log$ (drop ratio). Where the logarithms are common, the drop ratio is the ratio of the number of drops of the indicator solution in the alkaline tube to the number in the acid tube, and the values of k are as follows: Tetrabromophenol-sulphonphthaleïn, 4·1; methyl red, 5·0; dibromo-*o*-cresol-sulphonphthaleïn, 6·3; dibromothymol-sulphonphthaleïn, 7·1; phenol-sulphonphthaleïn, 7·7; *o*-cresol-sulphonphthaleïn, 8·1; thymol-sulphonphthaleïn, 8·8. W. P. S.

New Calomel Electrode. A. E. Koehler. (*J. Biol. Chem.*, 1920, **41**, 619-620.)—The apparatus is arranged in such a manner that each of the potassium

chloride solutions employed, when mixed after use, may be readily rinsed out and replaced by fresh solution. The $\frac{N}{10}$ potassium chloride occupies the left side of the apparatus as far as stopcock *B*, while the remainder is filled with the saturated

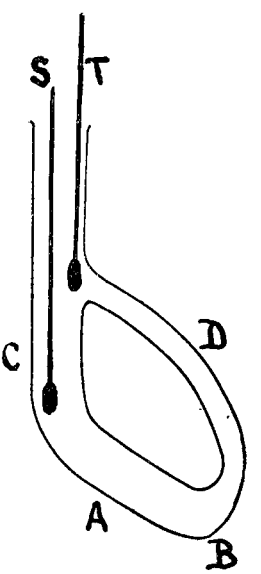


solution. Contact is made between the two solutions around *B* which is not greased. After use, the tube extending from *A* to *B* is washed out with $\frac{N}{10}$ potassium chloride solution from the reservoir, and, similarly, the section from *B* to *C* is rinsed with the saturated solution by suitable manipulation of the stopcocks. During a period of two months' continual use the E.M.F. of the electrode remained constant.

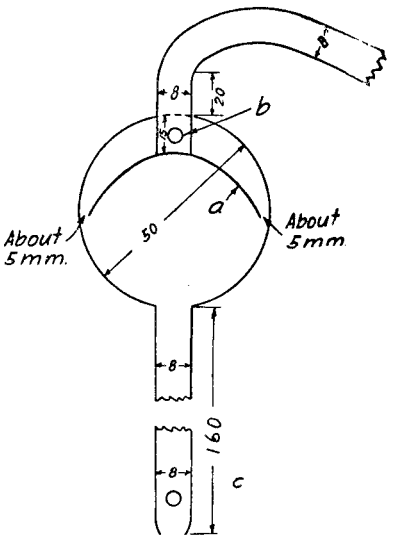
T. J. W.

Apparatus for the Determination of Melting-Points. L. M. Dennis. (*J. Ind. and Eng. Chem.*, 1920, **12**, 366-368.)—In determining the melting-points of substances in capillary tubes attached to a thermometer and immersed in pure concentrated sulphuric acid, the accuracy of the results is greatly increased by using a tube of the form shown in the diagram for the sulphuric acid bath. This accelerates the circulation of the acid and thus equalises its temperature, as may be demonstrated by means of thermometers *S* and *T* fixed in the positions shown. The difference between the temperatures recorded by the two thermometers is much smaller, even when the tube is rapidly heated, than when a Thiele tube is employed and heated more gradually.

C. A. M.

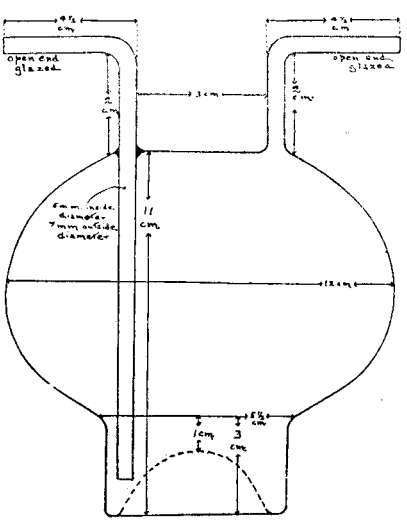


Distillation Connecting Bulb. C. M. Clark. (*J. Ind. and Eng. Chem.*, 1920, **12**, 366.) The bulb shown in the diagram has been designed to prevent spray from



being carried over into the distillate. This is effected by means of a baffle plate, *a*, in the form of a deep watch-glass, which extends to within about 5 mm. of the sides of the bulb, and prevents any spray from reaching the exit holes at *b*. C. A. M.

Condenser for the Determination of Crude Fibre. C. A. Clemens. (*J. Ind. and Eng. Chem.*, 1920, **12**, 288-289.)—A condenser has been designed to rest inside the top of a lipless beaker, such as is used in digesting, for the estimation of crude fibre. It consists of a glass bulb (see fig.), one side of which is blown in such a manner as to extend downward. The lower surface of this projection is concave; thus the bottom is ring-shaped, and furnishes a suitable surface upon which the apparatus may rest when not in use. Into the top part of the bulb two glass tubes are sealed, one serving as an inlet and the other as an outlet for a stream of cold water. The condenser may be supported by attaching a wire to the inlet and outlet tubes, and fastening it to an iron rod clamped to a ring stand; the beaker can then be removed without disturbing the condenser. Owing to the concave surface of the effective portion of the condenser, an increased cooling area is obtained, and foam is prevented from rising to the top of the beaker. The condenser may be used with lipless beakers ranging in size from 500 to 1,000 c.c. J. F. P



REPORTS.

Report on the Work of Inspectors of Foods for the Year 1918-19. A. W. J. Macfadden. (Extract from the Annual Report of the Medical Department of the Local Government Board for 1918-19. H.M. Stationery Office, 3d. net.)

Work of Inspectors of Foods.—During the period covered by the report it has been found necessary to devote much attention to the inspection of imported meat. A considerable proportion of the meat was of very poor quality, and some of it had been imported from regions where stock is used chiefly for draught purposes, and feeding for market purposes is practically unknown. Such meat had seldom been seen in this country in the past, and to those unfamiliar with its appearance is often repulsive, and suggestive of wasting disease. A good deal of the meat, too, had suffered from rough handling and conveyance in unsuitable waggons. The surface was often dirty, and, in places, had become slimy or stale owing to exposure. These conditions were explained as having been due to difficulties in obtaining suitable labour and rolling stock for the conveyance of the meat.

Arsenic in Food Materials.—The steps taken by manufacturers of baking-powder materials in this country to safeguard their products from arsenical contamination appear to have been successful. It is desirable, however, that public analysts throughout the country should continue to keep food materials of this class under observation locally.

Matters Calling for Reform. (1) *Inspection of Home-Killed Meat.*—The question of the protection of the public from dangers due to the consumption of meat derived from diseased animals is one which the author considers still requires very much more attention than it has so far received. He discusses at considerable length the arrangements that have already been made for the provision of public abattoirs and the difficulties which have arisen owing to the continued preference of many butchers for old and unsuitable slaughter-houses. Until the Ministry of Food took over the control of the sale and slaughter of animals for food there was a large trade done in various parts of the country by unscrupulous dealers, who carried on a a highly lucrative business in the trading of diseased and emaciated animals for surreptitious conversion into meat, and no system of local meat inspection, however good, would serve to protect consumers against diseased meat in districts in which inspection is absent or inefficient. There is only one method of ensuring the freedom of meat from disease, and that is by careful examination of the carcase at the time of slaughter, when all viscera are available for inspection. The only practicable means by which this can be brought about is by requiring all animals intended for food purposes to be brought to a public abattoir and by providing skilled inspectors in sufficient numbers to inspect thoroughly, both before and after slaughter, every animal brought there. This would result in the closing of all private slaughter-houses as such, and, in order to be of practical advantage to public health, the requirements would need to operate in town and country alike. Their

application to urban areas alone would not be sufficient, as this would merely accentuate past evils by driving the trade in diseased animals exclusively into rural areas where there is no inspection at all. The position in regard to this matter is, from the public health point of view, most unsatisfactory. The difficulties in the way of dealing with it in the past have been very great, but the opposition to public abattoirs which has hitherto been encountered from butchers may possibly be modified in future on account of the altered conditions which have resulted under the Ministry of Food's restrictions as to slaughtering.

(2) *Supervision of Places where Food is Prepared or Kept for Sale for Human Consumption.*—The powers which local authorities possess under the Public Health Acts are inadequate for securing such a standard of suitability and cleanliness of premises, and of care in the materials used and processes employed in factories and other places where food is prepared or kept for sale, as is necessary to maintain conditions in these places which would be reasonably safe from the point of view of consumers of the materials manufactured there. The nuisance clauses of the Public Health Act and the procedure laid down in the Act for dealing with nuisances are quite unsuitable for controlling such places. Very unsavoury details of the foul conditions existing in many places where pies, sausages, and other foods are prepared for sale are described in the report, and it is stated that it has become a matter of increasing urgency that the regulation of this class of premises should be undertaken. The report closes with some general remarks upon problems in human nutrition, more particularly in connection with the accessory factors or " vitamines," concerning which there has been so much recent discussion. Processes of manufacture and the manner in which food is prepared may exert a profound influence upon its ultimate vitamine content. The antiscorbutic vitamine of fresh vegetables is destroyed by drying or by prolonged cooking, and the antineuritic vitamine in foodstuffs, though more stable, is affected injuriously by exposure to high temperatures, such as may be employed in the sterilisation of foods. Many proprietary foods and invalid foods appear to be practically devoid of vitamines. Organised research on the subject of accessory food factors, or vitamines, is already in progress in this country. Other aspects of the problem of nutrition, especially those relating to the economic situation, are, however, in urgent need of research work properly organised and directed on systematic lines. H. F. E. H.

Food Values and Dairy Products. O. R. Overman. (Circular No. 235, Agric. Exper. Sta., University of Illinois.)—The circular deals very fully in a statistical manner with the food values of all the more usual dairy products, numerous tables of chemical composition, calorie value and cost per calorie being included in the work. The cheapness of dairy products as regards both protein and total energy is emphasised, and stress is laid upon the advantage which would accrue from the standpoint of economy if greater use were made of them by purchasers of flesh and other foods. Emphasis is also laid upon the fact that milk containing 4 per cent. fat is a more economical source of both protein and energy than are meat, eggs, poultry or fried fish, while even skim milk is a far cheaper source

of protein and energy than are other foods of animal origin, and, considered only as a source of protein, it is more economical than dried peas or beans. Comparisons on the energy basis alone are, it is pointed out, in many cases unfair to one or other of the foods compared, and it is advisable always to bear in mind that a better way to look at the problem is from the point of view of the number of calories that can be bought for a given sum, and, from the tables appended tabulating this information, it becomes very evident that milk is relatively inexpensive as compared with many other foods commonly considered to be much more nutritious. H. F. E. H.

REVIEW.

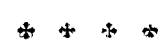
LEGAL CHEMISTRY AND SCIENTIFIC CRIMINAL INVESTIGATION. By A. LUCAS. Pp. viii + 181. London: Edward Arnold. Price 10s. 6d. net.

Every analyst in general practice has occasionally to solve problems of a legal character, and in such cases will generally find that he can obtain little assistance from ordinary textbooks. Usually he has to devise his own methods, and to test them by the results of experiments upon known materials under artificial conditions. As director of the Government Laboratory in Cairo, the author of this book has been exceptionally placed for gaining experience in connection with legal and criminal cases in which chemical methods have been required, and he has embodied his notes on these cases under a series of classified headings. The precedent might well be followed, and if other chemists would publish notes upon the methods used in similar out-of-the-way cases a literature dealing with forensic chemistry (as distinct from toxicology) would eventually be available.

The subjects dealt with are arranged in alphabetical order for easy reference, and cover a great deal of ground, since they practically touch upon most branches of criminal activity, as will be gathered from the headings of some of the sections. These include subjects as remote as forged antiquities, examination of bullets, hashish, damage to crops, and finger-prints. In many of the cases no original methods of examination have been devised, but microscopical and chemical methods have been adapted to the special end in view. In other cases, however, the author gives interesting details of his investigation in connection with special subjects, such as the disintegration of building-stones in Egypt, and the nature of the material used for embalming mummies. At the end of each section references are given to the literature which has a bearing upon questions likely to arise in connection with the subject. The section to which most space has been given is that dealing with the examination of documents, and this is full of interesting information as to the use of early inks and papers in Egypt. The advantage of having authentic information as to the dates of changes in the composition of writing materials is shown in several of the instances cited, and in particular in connection with forgeries where an attempt has been made to imitate an old ink. In one case mentioned all but five

out of 168 documents were falsified in all manner of ways, from the simple forgery of a signature to the fabrication of the entire document. The value of chemical and microscopical examination is also made evident in connection with the cognate subjects of tampering with letters in transit and the fabrication of seals. The sections dealing with alcoholic liquids and with food and drugs are perhaps a little out of place as they stand, since much of the information (apart from details concerning Egyptian products) will be familiar to most analytical chemists. The same criticism may also be applied to the section on the pollution of water by sewage, and, to bring these two sections within the general scheme, details of exceptional cases within the author's experience should be given.

This, however, is a minor criticism, and, regarded as a whole, the book may be strongly recommended to all chemists whose work is likely to include legal questions. It is to be hoped that the author may see his way to expand his notes into a general textbook of forensic chemistry. C. A. MITCHELL.



THE INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

PASS LIST.

APRIL (1920) EXAMINATIONS.

THE results of the examinations of the Institute recently held in London, Manchester, and Sheffield have now been published. The following candidates were successful :

For the Fellowship : In the branch of Organic Chemistry, R. O. Eames, B.Sc. (Wales), and H. W. B. Clewer ; in the branch of the Chemistry of Food and Drugs, Fertilisers and Feeding-Stuffs, Soils and Water, Norman Ratcliffe ; in the branch of the Chemical Technology of Textile Manufacture, E. Clayton.

For the Associateship : In the branch of Organic Chemistry, E. C. Pickering, B.Sc. (Lond.), and S. B. Phillips ; in the branch of the Chemistry of Food and Drugs, Fertilisers and Feeding-Stuffs, Soils and Water, F. N. Appleyard and A. Lees; in the branch of the Chemical Technology of Textile Manufacture, R. Humphries; in the branch of the Chemical Technology of Cement Manufacture, S. Bowman.

For the Certificate : In the branch of the Chemistry of Food and Drugs, Fertilisers and Feeding-Stuffs, Soils and Water, S. Dixon, M.Sc., A.I.C.