

# THE ANALYST

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

### Points Arising from the Analytical Standardisation of British Chemical Standards.

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*(Read at the Meeting, May 6th, 1925.)*

WITHOUT attempting to give either a history or description of the British Chemical Standards' movement, as these have been given in various papers and in the "Three-Year Reports," we should mention that during the nine years it has been in operation, for 39 different constituents 136 standards have been determined (Tables I. and II.), each by a number of chemists (from 10 to 20), experienced in that class of analysis, and representing the different interests—makers, sellers,

TABLE I.

CONSTITUENTS STANDARDISED AND THEIR RANGE (No. 1).

Number of Standards.	Constituents Standardised.	Steel Range.		Cast Iron Range.	
		From. Per Cent.	To. Per Cent.	From. Per Cent.	To. Per Cent.
21	Carbon, total	0.039	1.21	3.06†	3.12†
2	„ combined	all	all	0.39†	0.734†
2	„ graphitic	—	—	2.67†	2.387†
10	Silicon	0.006	0.187		1.989
13	Sulphur	0.020	0.075	0.031	0.047
13	Phosphorus	0.008	0.105	0.026	0.049
14	Manganese	0.043	0.914		0.688
8	Arsenic	0.024	0.14	0.031	0.042
6	Nickel	0.06	3.99	—	—
2	Chromium	0.861	3.01	—	—
2	Vanadium	0.273	6.791	—	—
1	Cobalt		4.76	—	—
1	Tungsten		16.21	—	—
2	Titanium	—	—	0.052	0.108
1	Iron		99.64	—	—
98					

See continuation.

† Some grms. sieved off, to make more uniform, when preparing the sample.

TABLE II.

CONSTITUENTS STANDARDISED AND THEIR RANGE (CONTD.) (No. 2).

Number of Standards.	Constituents Standardised.	Ranging from	
		Basic slag. Per Cent.	Iron ore (Haematite). Per Cent.
From Table I. 98			
2	Lime .. .. .	44.73	2.05
2	Magnesia .. .. .	6.85	1.22
1	Manganese .. .. .	—	trace
2	Iron—total .. .. .	8.93	58.20
1	Iron as FeO .. .. .	—	0.63
2	Silica .. .. .	16.15	8.13
2	Phosphoric acid .. .. .	12.92	0.128 = P. 0.056
—	Tri-calcic phosphate .. .. .	28.22	—
1	Alumina .. .. .	—	1.83
1	Arsenic .. .. .	—	0.01
1	Copper .. .. .	—	0.037
5	Ni & Co, Cr, V, Zn, Pb .. .. .	—	nil
1	Potash .. .. .	—	0.26
1	Soda .. .. .	—	0.10
—	(Mixed alkalis .. .. .	—	0.335)
1	Titanic acid .. .. .	—	0.116
1	Sulphur .. .. .	—	0.063
1	Combined water .. .. .	—	1.56
1	Carbonic acid .. .. .	—	1.41
—	(including C .. .. .	—	3.06)
1	Fe insol. in HCl .. .. .	—	0.12
1	Insoluble residue .. .. .	—	9.00
1	S. as SO <sub>3</sub> .. .. .	—	0.153
1	Loss on calcination .. .. .	—	2.96
Total	128		
	8 (In white metal "A" (lead-base), viz. Pb, Sb, Sn, Cu, Fe, Bi, As, Zn.)		
Total	136		

buyers, users, Government Depts., including the United States Bureau of Standards, and independent analysts, both in this country and several others. In fact, we believe it will be readily acknowledged that the average standing and experience of each group testing a sample is as high as could be obtained.

As organisers, we have compiled the results and been cognisant, in most cases, of the methods used by the co-operators of this movement, and since, in addition to this, one of us has also, from the first, been on the working Committee (No. 5) of the Iron and Steel Institute for the preparation of steel standards (which was commenced shortly afterwards as a result of the first-named movement), and have also received much information and help from the United States Bureau of Standards, we have, we believe, had unequalled opportunities for observing the methods and results in general use for the constituents tested.

Confining ourselves, however, to those of the British Chemical Standards' movement, the summarised results show the following *differences* on the total quantities given, and for comparison are also shown the differences which would be yielded by about the minimum variations in weight of precipitate or volume of titrating solution that can generally be worked to. (See Tables III., IV. and V.).

TABLE III.

## STEEL AND CAST IRON.

Composition.	DIFFERENCES.		Yielded.			
	Found.	Differences actually found under exceptionally favourable conditions.	Weight used on Grms.	Test made to	=	Per Cent. + or -
Carbon up to ..	0.35	0.025	} Steel 2.727 G } C. Iron† .909 G	0.001 g. CO <sub>2</sub>	0.001 g. CO <sub>2</sub>	0.010 0.030
	0.36—0.75	0.033				
	0.76—1.20	0.05				
Silicon up to ..	0.10	0.025	} Steel 4.693 G } C. Iron 2.396 G	0.001 g. SiO <sub>2</sub>	0.001 g. SiO <sub>2</sub>	0.010 0.020
	0.10—0.20	0.032				
Sulphur up to	0.08	0.0077 (0.008)	} St. & C.I. { 5.0 V } 5.0 G	0.1 c.c. N/5 I	0.001 g. BaSO <sub>4</sub>	0.001 0.003
Phosphorus up to	0.05	0.0062				
	over 0.10	0.012	(low P.)			
Manganese— Plain carbon steels	up to 0.45	0.021	Steel	0.2 V	0.1 c.c. sod. arsen.	0.008
	0.46—1.0	0.048	St. & C.I.	0.1 V	0.1 c.c. ,, ,,	0.015
Alloy steels, cast iron up to	0.7	0.050	Steel	1.0 V	0.1 c.c. N/10 FeSO <sub>4</sub>	0.011

\* G = Gravimetric; V = Volumetric.

† In cast iron the carbon was 3.12 per cent., but the differences were not shown in this table.

The preparation of materials for standards is a very special matter, and each type presents different problems both to get it into the most suitable condition for analysis and also to ensure homogeneity, and not only was the most uniform material obtainable used, but everything that careful consideration and long experience could suggest has been done to ensure these qualities, whilst the preparation throughout has been conducted under laboratory conditions by experienced chemists, so that variation of sample can be confidently regarded as eliminated for practical purposes.

As further showing that there is no cause for differences arising from hurry either in preparation of samples or of analysis—though in ordinary cases these causes no doubt account for some variations—preparation alone of as little as 200 lbs. generally takes from six to eight weeks per sample; whilst the analytical standardisation, before sufficient agreement is reached, may take several months.

As to care in the selection of methods of analysis, or conduct of them, we may be sure that men of such standing, especially knowing that their results were for publication, naturally used those they believed to be the best, and conducted them with every care.

Indeed, sometimes, when their results have differed widely from the general average, it has been a somewhat delicate matter to suggest that they should repeat them. But we have had to do this with most chemists in turn, no matter how high their standing, and invariably it has been received in the right spirit. However, as we have always told our co-operators, "it should be borne in mind

TABLE IV.  
DIFFERENCES.

Constituents Tested.	Material.	FOUND.			YIELDED.		
		Total amount (average). Per Cent.	Range of differences found. Per Cent.	Extreme + or - cover (from av.). Per Cent.	Weight used. Grm.	Test made to.	= Per Cent. + or -
Iron	O	58.20	<b>0.21</b>	0.11	1 V	0.1 c.c. N/5 $K_2Cr_2O_7$	0.112
	S	8.93	0.65	0.47	1 V	0.1 c.c. N/5 $K_2Cr_2O_7$	0.112
Iron as FeO	O	0.63	0.23	0.13	1 V	0.1 c.c. N/5 $K_2Cr_2O_7$	0.112
Iron insol. in HCl	O	0.12	0.11	0.08	1 V	0.1 c.c. N/5 $K_2Cr_2O_7$	0.112
Phosphorus (equiv.)	S	5.64	<b>0.34</b>	0.23	0.2 V	0.1 c.c. N/2 NaOH	0.034
					0.2 G	0.005 grm. phospho. molyb.	0.041
Phos. acid	S	12.92	<b>0.79</b>	0.52	0.2 V	0.1 c.c. N/2 NaOH	0.077
					0.2 G	0.005 grm. phospho. molyb.	0.093
P.	O	0.056	0.008	0.004	0.5 G	0.001 grm. $Mg_3P_2O_7$	0.128
					2 V	0.1 c.c. N/6.74 NaOH	0.001
As.	C.I.	0.037	0.017	0.010	G	molyb. 0.001 grm.	0.0008
					5 V	0.1 c.c. N/75 I	0.001
As.	Steel	0.054	0.011	0.007	5 V	0.1 c.c. N/75 I	0.001
As.	O	0.011	0.013	0.007	5 V	0.1 c.c. N/75 I	0.001
As.	W.M.	0.058	0.040	0.022	2 V	0.1 c.c. N/75 I	0.0025
Copper	W.M.	0.37	0.21	0.12	1 V	0.1 c.c. $Na_2S_2O_3$	0.05
Copper	O	0.037	0.015	0.008	5 V	0.1 c.c. $Na_2S_2O_3$	0.01
$SO_3$	O	0.153	0.028	0.017	2 G	0.001 grm. $BaSO_4$	0.017
S.	O	0.063	0.017	0.010	2 G	0.001 grm. $BaSO_4$	0.007
Lime	S	44.73	<b>0.80</b>	0.47	0.5 V	0.1 c.c. N/5 $K_2Mn_2O_8$	0.112
					0.5 G	0.001 grm. CaO	0.20
Lime	O	2.05	<b>0.62</b>	0.46	1.0 G	0.001 grm. CaO	0.10
					1.0 V	0.1 c.c. N/5 $K_2Mn_2O_8$	0.05
MgO	S	6.85	<b>0.68</b>	0.43	0.5 V	0.001 grm. $Mg_2P_2O_7$	0.072
MgO	O	1.22	<b>0.29</b>	0.16	1.0 G	0.001 grm. $Mg_2P_2O_7$	0.036
$K_2O$	O	0.26	<b>0.27</b>	0.15	1.0 G	0.001 grm. KCl	0.064
					G	0.001 grm. $K_2PtCl_6$	0.019
$Na_2O$	O	0.10	0.14	0.08	1.0 G	0.001 grm. NaCl	0.053
Mixed alkalis	O	0.335	0.23	0.14	1.0 G	0.001 grm. NaCl + KCl	0.05

O = Iron ore "A." S = Basic slag. C.I. = Cast iron. W.M. = White metal "A."  
V = Volumetric. G = Gravimetric.

The figures in heavy type in Tables IV. and V. indicate some of the chief divergences.

that we do not attempt in any way to act as judges of who is right and who is wrong, and an extreme result is not necessarily incorrect, whilst, provided the author of it is sufficiently certain of its accuracy, his adherence to it may lead to progress through the investigation of methods." Yet, as we have seen, even the finally considered results often showed appreciable differences.

At first sight it appears surprising how differences occur, even with constituents that are considered very simple to determine. For instance, what would seem to most chemists to be simpler than the determination of silicon in hæmatite pig iron? Yet, it was only after repeated tests and investigation that reasonable agreement was obtained.

Again, when two or three years ago, a basic slag was prepared, a well-known chemist of high standing, often referred to in cases of dispute over that material,

TABLE V.  
DIFFERENCES.

Constituents tested.	Material.	FOUND.			YIELDED.		
		Total amount (aver.) Per Cent.	Range of differences. Per Cent.	Extreme + or - (from av.) Per Cent.	Weight used on.	Test made to.	= Per Cent. + or -
Alumina	O	1.83	<b>0.55</b>	0.32	1.0 G	0.001 grm. Al <sub>2</sub> O <sub>3</sub>	0.10
					1.0 G	0.001 grm. AlPO <sub>4</sub>	0.042
TiO <sub>2</sub>	O	0.116	0.08	0.06	1.0 V	0.25 c.c. Sod. titanate	0.0025
SiO <sub>2</sub>	S	16.15	<b>0.80</b>	0.40	1.0 G	0.001 grm. SiO <sub>2</sub>	0.10
SiO <sub>2</sub>	O	8.13	<b>0.45</b>	0.23	1.0 G	0.001 grm. SiO <sub>2</sub>	0.10
					2.0 G	0.001 grm. SiO <sub>2</sub>	0.05
Insol. Res.	O	19.0	0.24	0.14	1.0 G	0.001 grm. Insol.	0.10
" "	S	17.27	0.33	0.20	1.0 G	0.001 grm.	0.10
Cd. H <sub>2</sub> O	O	1.56	<b>0.35</b>	0.19	2.0 G	0.001 grm.	0.05
CO <sub>2</sub>	O	1.41	<b>0.41</b>	0.21	2.0 G	0.001 grm.	0.05
Cd. H <sub>2</sub> O, CO <sub>2</sub> , & C		3.06	0.49	0.26	2.0 G	0.001 grm.	0.05
Loss on calcination	O	2.96	0.4	0.24	2.0 G	0.001 grm.	0.05
Nickel	Steel up to 0.61 % from 3.367 to 3.985	0.317	0.065	0.037	3.0 G	0.001 grm. dimethyl-glyox.	0.007
		3.676	<b>0.128</b>	0.071	V	0.1 c.c. KCN	0.005
					1.0 G	0.001 grm. dimethyl-glyox.	0.02
					V	0.1 c.c. KCN	0.014
Chromium	Steel	1.936	0.107	0.065	2.0 V	0.1 c.c. N/10 K <sub>2</sub> Mn <sub>2</sub> O <sub>8</sub>	0.009
Vanadium	Steel	0.532	<b>0.113</b>	0.077	2.0 V	0.1 c.c. N/20 K <sub>2</sub> Mn <sub>2</sub> O <sub>8</sub>	0.013
Zinc	W.M.	<b>0.04</b>	<b>0.13</b>	0.12	2.0 G	0.001 grm. ZnS	0.032
Lead	W.M.	82.56	<b>0.73</b>	0.36	0.5 G	0.001 grm. PbMoO <sub>4</sub>	0.113
					0.5 G	0.001 grm. PbSO <sub>4</sub>	0.137
Tungsten	Steel	16.21	<b>0.50</b>	0.32	2.0 G	0.001 grm. WO <sub>3</sub>	0.04

O=Iron ore "A" S=Basic slag. W.M.=White metal "A."

It will be noticed that with a small amount of zinc the differences are three times as great as the total amount.

said he could not see any useful purpose in standardising the lime content, as anyone could determine lime. Yet in that case, too, it was only with great difficulty that, after a long time, results of sufficient concordance could be obtained to justify their being issued.

The same thing applied to several other constituents, and history has repeated itself recently with lime, alumina, magnesia, potash, and soda of the Hematite Iron Ore standard just prepared; and the irony of it is, that it is not due to what might properly be called "bad work."

Every successive standard prepared has shown us more and more convincingly the great need for standards, not only for their own value for scientific and commercial purposes, but also because of the "clearing house" work which their preparation entails, and forcing comparison and investigation of methods. This is helpful to co-operators themselves, to whom are brought home the experiences, and who benefit correspondingly.

Sir Herbert Jackson, when presiding at a Conference of the Institute of Chemistry Standards' Committee, with representatives of the Federal Council for Pure and Applied Chemistry, including representatives from your own Society,

the Society of Chemical Industry, Chemical Society and Institute of Metals, at London, on 26 June, 1919, cited, as showing the need for standards, the instance of glass samples, and how greatly the analyses of a number of chemists of standing had varied, yet each of them was convinced he was not wrong, and, Sir Herbert humorously remarked, "the one thing I was quite sure of was that our results were right."

Differences are, no doubt, in the main due to each chemist differing in judgment and in interpretation of the many small points of working detail of a method, which collectively have considerable effect. One can see, on studying the notes of methods of the iron ore, how many modifications there are of almost any method.

Several of "the causes that bring about differences in analyses" were reviewed in a paper by Baron Juptner von Jonstorff on "The Introduction of Standard Methods of Analysis,"\* the remedy advocated being clear from its title. We do not propose to recapitulate these here, but they may be usefully referred to.†

And here arises a question which it is of importance should be decided, and a definition given. What constitutes an accurate method? Certainly it does not necessarily depend on the number of precautionary operations carried out.‡ Is not the evidence that should be accepted the closeness of agreement *between a number of chemists* testing the same uniform sample, rather than the mere close agreement of duplicates by the same chemists, or of tests by two or three chemists working side by side? In other words, is it not the method which offers fewer chances of different interpretation in its working? If so, we believe there never has been in this country a means of gauging this before on such a scale.

Again, it is now evident that there is no justification for thinking that good chemists never get incorrect results, and that it is only unqualified, insufficiently trained chemists, or bad workers, who do.

How can chemists know whether or not there have been mistakes, unless something has revealed them or some reliable test applied has shown that there is no cause for thinking they have occurred?

For this reason we regard it as extremely important, especially with determinations in which small differences matter, constantly to run through reliable standards of *known* composition side by side with samples being tested, of which, of course, the composition is *not* known then. One may go on making analyses, and most of them be quite reliable, but occasionally, without any idea that it is occurring, error may creep in.

To illustrate this, we took out for one standard which was frequently used, the differences obtained for sulphur and phosphorus from the standard figures when running these samples through, side by side, with other samples over a period of ten months. The figures represent for each element the results by two assistants and two methods.

\* *J. Iron & Steel Inst.*, 1896, 68.

† See also the authors' paper on "The Unification of Analysis" (*loc. cit.*).

‡ See Figures, p. 348, and Diagrams, Plate XLII., *J. Iron & Steel Inst.*, No. 1, 1911. ("Mechanicalising Analysis as an Aid to Accuracy and Speed for Commercial Purposes.")

The standard referred to was "H."

				Sulphur	Phosphorus
				0.047 per cent.	0.035 per cent.
				Of total number of results.	
				Per Cent.	Per Cent.
No difference		..	..	21	38
Difference of	0.001	..	..	26	33
"	"	0.002	..	32	24
				— = 79	— = 95
"	"	0.003	..	10.5	90
				(negligible)	
"	"	0.004	..	—	5
"	"	0.005	..	—	5
"	"	0.006	..	10.5	—
				100	100

It will be seen that in 90 per cent. of the sulphur determinations, and in 95 per cent. of the phosphorus determinations, the differences were so small as to be negligible both from the analytical and commercial point of view, and could be taken as indicating that the methods were being worked correctly, and that the results found for the samples—of composition unknown until tested—were right. But 10 per cent. of the sulphur results showed sufficient difference to lead to disputes, and, if the samples exceeded specification by that amount, possibly to rejection of material. Also, 5 per cent. of the phosphorus results showed larger differences than one liked to pass without further tests.

In all these cases the indications given by the standard enabled further tests to be made until completely satisfactory results were obtained, but—and we wish to emphasise this point—*without the systematic use of standards there would have been nothing to show that there had been unsatisfactory working of the methods.*

It is interesting, too, to note the better agreement,—practically all differences being negligible—in the case of phosphorus, for which at least one, and often both, of the methods used were mechanicalised, than in that of sulphur, for which they were not.

In a former paper read by the authors before the Society of Chemical Industry (*J. Soc. Chem. Ind.*, 1919, 38, 15T.), in Table III. comparison of differences between the results of chemists using mechanicalised methods and those of chemists using ordinary methods in the determinations both of phosphorus and manganese in homogeneous material prepared for standards were given—each chemist having used what he considered the best method.

It will be noted that these comprise a large number of results obtained by numerous chemists; summarised they are as follows:—

		No. of results returned.	Ratio of differences shown by each method.
Phosphorus.	" Direct molybdate "	29	112
	" Separation of arsenic "	47	209
	" Mechanicalised "	50	100
Manganese.	" Bismuthate "	107	162
	" Persulphate (ordinary) "	33	141
	" Gravimetric "	20	104
	" Mechanicalised "	56	100

The same feature has been borne out in the analyses of later standards, particularly in the case of the basic slag, with which four methods showed, on phosphoric acid, a range of variation of 0.44, 0.42, 0.35, and 0.53 per cent. respectively, against the mechanicalised 0.10 per cent.

Mechanicalised methods are standardised methods arranged so as to *cut out a number of operations*, and simplify the few remaining ones as much as possible, so that each chemist automatically does these in the same way.

Hence everyone using such a method knows that he is doing just the same as everyone else using it, and it is the only type of method in which he can be reasonably sure of this.

The principle is now thoroughly proved over a number of years and is well recognised by many chemists—indeed the mechanicalised methods for each of these constituents in various materials are probably more widely used than any other methods for their determination, about ten million tests having been made.

Hitherto this has only been applied to *phosphorus* and phosphoric acid in steel, cast iron, slag, and phosphate, and to *manganese* in steel, cast iron, slags of several kinds, iron ores, and manganese bronze, but recently the same principle has been applied to the determination of *lime* in blast-furnace and steel slags, mineral phosphates, lime, limestone, calcareous ores, etc., for routine analyses in which rapid results of substantial accuracy are of importance and value.

To revert to the constituents which have been standardised; it is out of the question here to attempt to consider the methods used.

A number of notes on those used for steel and cast iron have already been published in the Appendix and Table III. of the paper just referred to; those on basic slag and iron ore, as well as later notes for sulphur and phosphorus in steel "P," are given on their certificates, where it is possible to compare the results of the different co-operators by the respective methods they have used. We hope, as far as practicable, to continue this course with white metal "A" (lead-base), about to be issued, and with other standards.

Incidentally it was rather surprising and interesting to the senior author to notice that apparently the most popular method for determining lime in ore is still the same old method that was in common use nearly 50 years ago (*viz.* burning off the oxalate to calcium oxide), for 12 out of 14 chemists had used this.

The main questions arising out of the facts that have been brought to light are: (1) Do the differences matter?; (2) if so, how are they to be avoided?

To the first we think there can only be one answer, both on practical and scientific grounds, "Yes!"

One has only to remember how much of the analysis done is for commercial ends—indeed substantially it is to these that analytical chemistry as a profession owes its maintenance—and in many cases very large sums depend on an analytical figure found which, as the facts show, cannot be guaranteed to within a difference quite sufficient to have a material commercial effect.

Just to mention two or three instances:—A consignment of steel costing thousands of pounds may be rejected because it is found by the referee chemist



to be 0.005 per cent. higher in sulphur or phosphorus than specified, though the maker's chemist may find it just under the limit, as would no doubt many other chemists.

Again, one-third of a unit per cent. of iron (say twopence on a 4000 ton cargo of ore) means £33, and this on half a million tons of ore—a by no means unusual quantity for an iron works of moderate size to use in a year—would mean over £4000.

Further, the differences shown for the bases lime and magnesia, and for silica, may mean a considerable effect on the working of a blast-furnace, its coke consumption, quality of iron produced, etc.

Then one might cite differences of price to be paid for basic slag according to whether it is one grade or another, whilst in non-ferrous metals variations on a much smaller weight still mean a considerable money figure.

Errors in analyses made for the control and guidance of manufacturing processes may have quite as serious, if less obvious, effects. As to analyses for scientific purposes, not only is the thought of error repugnant to every true chemist, but we know well that sooner or later so-called purely scientific purposes have great practical importance.

Nor is it a matter of indifference that even an appearance of inaccuracy in the eyes of many people casts a slur on the profession.

Commercial men are very much awake to this question of differences between chemists, and often make far more of them than is warranted; for there can be no doubt that chemists' work on the whole is good, and much more accurate than it appears to be, but the impression of inaccuracy conveyed is to a large extent their own fault for reporting analyses in terms of far greater exactitude than that to which they can test, and not pointing out the limits of the methods which are employed.

We had occasion, a year or so ago, in connection with the question of tolerances\* on chemical specifications, to put the differences in analyses of steel before some 550 chemists and engineers in various countries, and obtained incidentally a good many expressions of opinion on this subject of reporting.

In these days, when it is so frequently advocated in presidential addresses and the chemical press that chemists must do more in the way of propaganda to educate the public to an appreciation of the value of their profession to itself, is it not important that the matters we have brought forward should receive earnest consideration?

That the Institute of Chemistry has done much to raise the status of the profession of chemistry, will, we think, be readily admitted, and it may be that its policy of aiming at the exclusion from practice of all who have not gone through a course it has approved would, if achieved, do something to improve the opinion held by the public of the profession. But is not this a roundabout way?; and, as we have seen, that policy up to now has not removed the differences in analyses.

\* " *Engineers and the Interpretation of Chemical Specifications for Iron and Steel in Relation to Analytical Accuracy.*" (Cleveland Inst. Engineers, March, 1924.)

Would not one of the most effective ways to increase the esteem in which the profession is held be to consider and take measures which would have a direct effect on the improvement of the quality of chemists' work and remove any grounds for holding a poor opinion of them? And is not this work peculiarly appropriate for the Society of Public Analysts?

With regard to the *second point*, surely as a preliminary measure chemists should clearly recognise that there are *two main considerations* to be borne in mind in connection with analytical methods, and should differentiate between them.

The *first* is efficiency to serve commercial purposes—the vast majority of analyses are for this—and this demands agreement to such a degree that any slight variations occurring shall not affect the acceptance of material under specification, or the price paid for, or practical working of the material.

This consideration also often demands speed, and relative even more than absolute accuracy. Hence for this standardised or mechanicalised methods are needed.

The *second* consideration is increased accuracy for scientific progress. The desire to obtain absolute accuracy and to work out a better method than has hitherto been known is very laudable, but it should be kept in its place, and not confused with the first.

Surely it is not only very disconcerting, but also unfair, to buyers and sellers for a referee chemist suddenly to alter the method he uses—even though it may increase its accuracy—and thereby in effect alter the specification or price to be paid?

For those who object to standardised methods it is satisfactory to know that when chemical specifications are referred to in terms of a definite standard, the method used becomes a matter of indifference, provided it will give the recognised result for that standard; if it will not, then it may be assumed that the result for the sample is also incorrect. But, as seen in practice, there are very few methods that regularly give close agreement in the hands of a number of chemists.

This question was exercising chemists as far back as 1896, and one of the authors, in discussing Baron Von Jonstorff's paper in that year (*loc. cit.*), made some remarks which seem so germane to the situation to-day that we venture to quote some of them. He pointed out that there was far too much indiscriminate publication of new or slightly modified methods without adequate proof that they were reliable, and suggested there should be an International Commission to examine new methods, and said:

“If it became a principle before publishing a method to submit it to the Commission giving full particulars of wherein its advantages were supposed to lie, what reactions it involved, and what was considered new about it, they would thoroughly test it, and if it was of any use, publish an unbiased report on it. Further, if those carrying out the investigation were in ignorance of the identity of the author, and all methods not possessing a distinct advantage were ruthlessly condemned, the work would be more valuable. Such methods would be, as it were, “hall-marked,” and the credit reflected on the inventor would be proportionately greater; whilst there would be no need for

chemists to spend much time examining methods which proved useless, and more could be given to studying those recommended by the commission."

He also was of opinion that "though it was exceedingly improbable that any Commission would ever be able to make it compulsory to adopt its methods, it was highly probable that engineers would soon recognise its good work and specify that material should have a certain composition 'as tested by International Commission, Method 157.' These standard methods, with every details published, would be printed and sold like blue-books of the Patent Office, and both Referee and Works Chemists could then obtain them and work to them, and the latter would have the satisfaction of knowing they would not be changed at each new idea the Referee got.

"At the same time there would be no real hindrance to progress, as new methods would be continually investigated; and when, but not until there were real grounds for superseding a method, it would be officially cancelled and its substitute published, notification of this being given in the official weekly or monthly publication of the Commission."

It soon became evident to the authors that a first step necessary for any arrangement such as the foregoing to be successful, would be the provision of accurate and acknowledged standards on which to test the methods.

At that time there were none, but during the intervening 29 years, first the United States Bureau prepared a wide range (which, however, have been chiefly needed for their own consumption), and since then those referred to in this paper have become available, as have also a few methods, the *operations* of which have been standardised or mechanicalised.

It is hardly to be expected that standardised *descriptions* of analytical methods will ensure agreement, as chemists are certain to interpret some little points differently, and so bring about variations. But it is a step towards more uniform working, and, as we have seen, the majority of methods do not lend themselves to standardising the *operations*—mechanicalising—and, in most cases, all that can be done is to standardise the *description* of them. We are aware that since that date some progress has been made in the publication of such descriptions, but we are under the impression that the initiative for this has come rather from engineering or other bodies than from chemists.

If this is so, should this work be left for them to initiate; and can we wonder that the engineer is often thought to take precedence of the chemist? Is it not more appropriate that a body of analytical chemists like the Society of Public Analysts, should henceforth take it up and issue a series of well-proved methods in minute detail, emphasising the fact that *any deviation* might lead to error?

We do not suggest that you should seek to make their adoption compulsory; we do not think that principle is ever a success. But in doing such work you would be following for analytical chemistry the splendid example which the B.E.S.A. has set in the matter of engineering specifications.

#### SUPPLEMENTARY REMARKS BY N. D. RIDSDALE.

I should like to add a few remarks on the importance of not reporting analyses in such a way as to imply a greater accuracy than can be reasonably expected in practice.

In a paper on "Tolerances," already mentioned, read before the Cleveland Institution of Engineers, in March, 1924, reference was made to a letter we received from Dr. McCrae of the Government Laboratory, Johannesburg, Dr. McCrae pointed out that in rock analyses a chemist would be fortunate if, in determining silica on 0.5 grm., his duplicates showed a difference in weight of not more than one mgrm., yet this small error would make a difference of 0.2 per cent. of silica between the two results—*i.e.* one silica result might be 65.28 per cent. and another 65.48 per cent. The accuracy in practice certainly is not greater than 2 parts in 650, yet if the result be reported to two decimal places the implied accuracy is 20 times as great, *viz.* 1 part in 6500. Dr. McCrae reminds us that the implied accuracy is greater than in the best atomic weight determinations!

Again, chemists regularly report the volatile matter in coals to two decimal places (until recently we did so ourselves), and even the Fuel Research Board recommended this in its recent Report on methods of analysis—yet we know that, even using the standardised methods recommended by this Board, differences of 2 to 5 mgrms., *i.e.* 0.2 to 0.5 per cent. on duplicates would be regarded as satisfactory. Here, again, an accuracy of 1 part in about 3000 is implied, whereas the accuracy in good ordinary practice is not greater than 2 parts in 300, or one-twentieth of that implied.

It is fairly safe to say that in good ordinary practice on inorganic analysis quantitative results cannot be expected to be accurate to more than 3 (and sometimes not more than 2) significant figures. Thus sulphur in iron might be reported as, say, 0.112 per cent.; manganese in iron, say, 1.12 per cent.; silica in iron ore, say, 11.2 per cent.; and so on.

To illustrate this more clearly, I will show in one column a typical example of how the complete analysis of an iron ore is frequently reported, and in another column how it might be reported in order to give a truer indication of the accuracy of the analysis,

	Per Cent.	Per Cent.
Ferric oxide .. .. .	81.850	81.8--
Ferrous oxide .. .. .	0.640	0.64-
Manganous oxide .. .. .	trace	trace
Phosphoric acid .. .. .	0.046	0.046
Arsenic acid .. .. .	0.009	0.01-
Copper oxide .. .. .	0.055	0.055
Lime .. .. .	1.736	1.74-
Magnesia .. .. .	1.132	1.13-
Potash .. .. .	0.221	0.22-
Soda ' .. .. .	0.105	0.11-
Alumina .. .. .	2.755	2.76-
Titanic acid .. .. .	0.105	0.105
Silica .. .. .	8.250	8.25-
Sulphuric acid .. .. .	0.240	0.24-
Combined water .. .. .	1.450	1.45-
Carbonic acid .. .. .	1.450	1.35-
	<hr/> 99.944	<hr/> 99.906

Where a complete analysis is being made and some of the constituents in smaller quantities are being reported to the third decimal place, it might be

desirable to put one or more dashes after the last significant figure where it ends at the first or second decimal place (as, for instance, in the case of ferric oxide in the above analysis).

This would, I think, be more satisfactory than putting noughts, as it would not convey a mistaken impression of accuracy, but would show that no slip had been made in the decimal place. In altering the method of reporting, a brief explanation to one's clients would be desirable in the first place, but there is little doubt that it would be better both for client and chemist in the long run to have figures issued in a way that does not imply an accuracy greater than it is possible to work to in practice.

An alternative would be to put a + or - sign with a figure to indicate the limits of probable error; e.g. ferric oxide, 81.85 per cent.  $\pm 0.1$  per cent., but, except for special circumstances, this would be a clumsy method, and chemists would probably differ as to the amount of error thus to be indicated.

It must be remembered that in commercial analyses the figure reported is subject to both errors of sampling and errors of analysis, and in the case of minerals and metals, at any rate, probably the error in sampling is greater than the errors in analysis.

Chemists may have some reluctance in disillusioning their clients as to the degree of accuracy of their analyses, but there are several stringent specifications to-day which give rise to disputes, because those issuing the specifications think that chemists can work to a finer degree of accuracy than methods will yield. Thus it is obvious that chemists are only making a rope for their own necks if they do not make clear to others present-day limitations of quantitative analysis.

#### DISCUSSION.

Dr. B. S. EVANS said that, while he wished to pay a tribute to the work done by Mr. Ridsdale in preparing standard samples, he rather dreaded the tendency involved in the standardisation of processes. He thought that mechanical processes would lead to mechanical chemists, ultimately to mechanicalised brains. Such mechanical chemists, using rigidly defined methods, would doubtless get *concordant* results, but he much doubted whether, in many cases that might occur (e.g. determination of phosphorus in vanadium steel), they would get *correct* results. The disagreement as to the arsenic content in the white metal referred to by Mr. Ridsdale was certainly outrageous, but was the homogeneity of the sample above suspicion? He concurred with Mr. N. D. Ridsdale's suggestions on the reporting of figures, but he would like to know why, in his specimen tabulation of results, the total was expressed to three places of decimals, whilst some of the items were not regarded as being accurate beyond the first place.

Mr. J. MYERS said that, although the difference of 0.2 per cent. on half a million tons might make a difference of £4000, yet the law of averages had to be taken into consideration. This, over a period, might considerably modify that sum. Broadly speaking, he continued, the vital ingredients in an ore—those upon which it was bought and sold—were iron, phosphorus, and silica. With regard to other elements, lime and the like, the blast furnace manager did not expect or require an analysis to be accurate to 0.10 per cent., or less, for the simple reason that local variations in the ore stock greatly exceeded such a narrow limit, for not only did

the individual pieces of ore vary very considerably, but, in addition, and in a wider fashion the part of the heap being worked could also similarly vary very considerably.

Mr. C. H. RIDSDALE, replying, said that time was wanting to deal with the points raised; his intention had been merely to bring the matter before the Society.

## A Contribution to the Analysis of Milk, Condensed and Desiccated Milk.

BY HARRY HURST, B.Sc., F.I.C.

*(Read at the Meeting of the Northern Section of the Society, June 27, 1925.)*

FROM an observation of the crystal-clear filtrates obtained in the examination of blood for sugar (Maclean's method) it occurred to me that dialysed iron would form a suitable precipitant for fat and casein in milk products.

The following methods are based on this separation:—

**MILK FAT.**—To 10 c.c. of milk, 20 c.c. of a 25 per cent. solution of condensed milk, or 20 c.c. of a 10 per cent. solution of dried milk, diluted slightly with water in a 250 c.c. beaker add 12 c.c. of dialysed iron (B.D.H.), dilute to about 50 c.c., mix thoroughly and immediately filter cold, using filter plate and paper and Geryk pump. Wash free from sugar. The filtrate is crystal-clear.

Transfer precipitate to original 250 c.c. beaker (the main bulk of the precipitate, including the paper, is transferred by means of a glass rod), and wash funnel with spray of hot concentrated hydrochloric acid. The volume now measures about 40 c.c.; add 5 c.c. of water.

Place the beaker in a boiling water bath for 10 minutes, remove, and allow it to cool.

Extract four times with ether, wash the ethereal layer free from iron, evaporate the ether, and dry and weigh the fat.

If during the extraction the ether is run well down, and the whole of the intermediate fluff removed, there is no emulsion formed on washing. The following percentage results were obtained:—

	Sweetened Condensed Milk		Dried Milk.	
Milk fat	9.28	9.29	27.70	27.60

**SUGARS.**—Dilute the filtrate from the dialysed iron precipitate to 200 c.c., and determine the sugars. Example:—

Milk sugar on 50 c.c. = 1.25 grms.

Cane sugar on 10 c.c. = 0.25 gm.

Milk sugar (anhyd.)      12.50 per cent.

Cane sugar                      44.64      „

**BORIC ACID.**—Dilute 20 c.c. of milk slightly, add 20 c.c. of dialysed iron, mix well and filter through paper. Wash with cold water so as to give about 70 c.c. Neutralise to methyl red (about 0.5 of 0.02 per cent. indicator in 60 per cent. alcohol), using N/20 acid and alkali. Add neutralised glycerin and complete titration to phenolphthalein.

1 c.c. alkali = 0.0031 grm. boric acid.

*Quantities unknown to the analyst.*

	Added.	Found.
Grains of $H_3BO_3$ per gall. of milk	17.4	18.0
	36.9	35.2
	0.0	3.0
	52.1	49.9
	13.0	11.7
	10.8	10.6

Unfortunately the method breaks down for sour milks.

	Added.	Found.
Decr. 18th.	17.4	18.0
19th.	„	16.3
20th.	„	17.8
22nd.	„ (sour)	20.6

The reaction to methyl red is indefinite at this limit.

In this case the procedure is—add a few c.c. of 0.5 N alkali to the filtrate from the dialysed iron, evaporate to dryness, and proceed as in Shrewsbury's method as modified by Liverseege and Bagnall.

The method here offers no advantages.

*Benzoic Acid.*—Twenty-five c.c. of milk—dilute slightly, add 20 c.c. of dialysed iron, agitate thoroughly and filter through paper. Wash to about 80 c.c.

Concentrate filtrate to 5 c.c. and transfer to a 5 inch by  $\frac{1}{2}$  inch test-tube. Make acid with two drops of hydrochloric acid, add 5 c.c. of ether and shake.

Now make ammoniacal . . . precipitate in ethereal layer indicates benzoic acid.

*To make the quantitative,* transfer to separator, make acid, and extract, using 10 c.c. and 5 c.c. (15 c.c. in all) of ether. Wash with water, evaporate ether spontaneously and dry *in vacuo*.

This method is sensitive to 0.0003 grm. benzoic acid, or, working on 25 c.c. of milk, to less than 1 grain of acid per gallon of milk.

Working on 25 c.c. of milk:

		BENZOIC ACID.	
		Added.	Found.
Added as sod. benzoate.	{	0.030 grm. = 84.0 grn./gl.	0.025 grm. = 70.0 grn./gl.
		0.006 „ 16.8 „	0.004 „ 11.2 „
		0.003 „ 8.4 „	0.0016 „ 4.5 „
		0.0015 „ 4.2 „	0.0015 „ 4.2 „
		0.0006 „ 1.68 „	0.0010 „ 2.8 „

These figures are not particularly satisfactory; some method other than gravimetric is desirable.

I am indebted to Mr. Fred Morris for much of the analytical work involved in this investigation.

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## Glass Filter Apparatus.

BY PAUL H. PRAUSNITZ, Dr.-Ing.

*(Read at the Meeting, April 1, 1925.)*

UNTIL recently glass filters were not employed for chemical laboratory work, notwithstanding the fact that fritted glass is hardly liable to be attacked by chemicals agents.

The Jena Glass Works of Messrs. Schott & Genossen are now making glass-filter-apparatus on the following new principle: High grade glasses of good chemical and thermal resistance are ground and sieved; particles of equal size are fused to form filter-discs containing pores of fairly equal diameter; and these discs may be fused together with the same kind of glass shaped in various patterns.

According to the numbers of mesh given to the sieves employed for sorting the grades of glass powder, the average size of pores has been determined as follows:—From 2 to 3, 110  $\mu$ ; 3 to 5, 60  $\mu$ ; 5 to 7, 40  $\mu$ ; and <7, 5  $\mu$ . Glass powder, not being plastic, like clay or fuller's earth, the manufacturing method had to be adapted to the burning of dry powder in flat moulds. By this means filter-slabs with large pores may be made as readily as fine-pore filters, whereas hitherto the production of filters with large pores of uniform size, made of plastic material, has been somewhat unsatisfactory.

To eliminate paper filters in those cases in which precipitates are to be filtered and weighed after being dried or heated at certain given temperatures, the Gooch crucible (with asbestos filters), and the Neubauer crucible (with platinum black filters) have been developed. The latter are relatively expensive, the former want careful preparation. Several types of crucibles have recently been made containing filters ready for use at any time. The Norton Company made crucibles of porous alundum, the Schott Glass Works brought out filter apparatus made of glass, the Berlin and the Rosenthal porcelain factories produced crucibles containing porous china filter discs. The alundum crucibles which I came across were porous throughout; this has the disadvantage that the liquid to be eliminated creeps up the walls and is not easily washed out. The glass and the porcelain crucibles, like the older Gooch crucible, having glazed walls and only filtering discs at bottom, offer far better possibilities for removing the liquid and washing the precipitate. The alundum and porcelain crucibles stand high temperatures



better. But, on the other hand, the glass filter apparatus have the following two very great advantages, due to the same reasons that glass is the chief material for all kinds of laboratory work: glass is *transparent*, and glass is most easily *brought into every shape* that may be necessary for the work on hand.

If highest thermal resistance is to be combined with transparency, *quartz* apparatus may be used; crucibles of transparent quartz fused with silica filter discs combine these advantages.

For quantitative analysis, especially when drying temperatures of 110 to 150° C. are required, the glass filter crucible is the best shape (Fig. 1). If it is to be heated to red heat, a temperature up to 600° C may be employed, but in that case it is preferable to use an electric furnace permitting of a slow and regular heating and re-cooling of the glass crucible. For filtering, the crucible is fitted into an adapter by means of a rubber ring. The adapter is placed on a suction-bottle joined to an air-pump. Coarser precipitates, such as silver chloride, are retained by medium-pore filters (type 5-7); but, as a rule, fine-pore filters (<7) are preferred, suited as they are for retaining fine precipitates such as cuprous oxide or barium sulphate. I may add that ultra-filtration with the Schott crucibles has so far not been attained unless a layer of an adequate material has been placed on top of the filter-disc.

In the case of white precipitates filter-apparatus with coloured glass discs are available. These may be fused with white glass mantles, so that the whole process of filtration can be closely followed.

Micro-filters of different types are fitted with glass filters and adapted to the usual methods of micro-work.

Apart from quantitative inorganic analysis, there are numerous organic analytical methods for which glass filters may be employed. Allihn tubes of 20 mm. diameter, with filter-discs <7 fused in, may even be carefully heated with a small gas flame if wrapped in asbestos paper, and then cooled with the requisite care. All types of extraction apparatus may be fitted with glass filters. In the case of the Soxhlet extractor a filter disc can be fused right across the extraction-tube, a small tube being fixed so as to allow the air in the lower chamber to escape (Fig. 2). Or a high-walled crucible may be inserted into the usual Soxhlet extractor in place of a paper holder (Fig. 3). In either case the process of extraction is open to full observation, and the apparatus can be used over and over again. The crucible may be weighed with its contents before and after extraction, thus checking the determination of the extracted matter. The extraction liquids are not limited to the usual organic compounds. Liquids which would attack cellulose (*e.g.* 20 per cent. hydrochloric acid) may be used for extracting minerals in glass filter extractors. Many other special types of extractors have also been constructed.

The methods of qualitative inorganic analysis are, perhaps, more liable to be transformed by the glass filter than any other laboratory operation. A small Buchner funnel (Fig. 4), fitted with a <7 filter disc, is held by a light soft rubber plate on the top of a large test-tube with lateral tube supported by an appropriate

light iron stand, and joined by a rubber hose to the suction-pump (Fig. 5). Common test-tubes placed loosely inside are exchanged after every operation. In the course of the analysis each precipitate is re-dissolved, leaving the glass-filter clean for the next operation. Thus, for example, the successive stages in the analysis of a mixture of the nitrates of silver, antimony, copper, and calcium, may be carried out in a single filter, which is finally left as clean as it was before use. The whole course of qualitative work is thus brought to almost quantitative accuracy.

For preparing chemical compounds, a whole series of Buchner funnels, up to 120 mm. diameter, is available (Figs. 6 and 6a). Coarser precipitates are retained by large-pore filters. These may be cleansed by rinsing with water from the

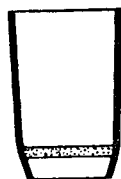


Fig. 1



Fig. 3



Fig. 2

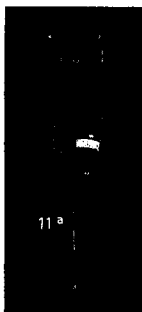


Fig. 4

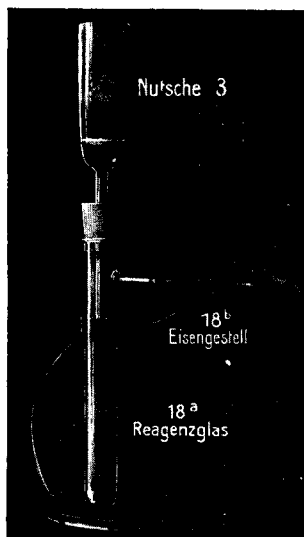


Fig. 5

reverse side. Finer filters, when clogged, may be purified by solvents. Precipitates which are fine, but absolutely insoluble (silicates, highly ignited oxide of iron, and the like), had better not be used, for in such cases the filters may be clogged and definitely spoiled. Should the precipitate be of special preparative value, as is often the case, the filter disc may be given a high polish before it be fused into the funnel. From a polished filter the finest precipitates are removable by means of a rubber device. In the case of red phosphorus, for example, suspended in water, it is possible to remove the fine coloured substance almost completely from a polished filter—certainly to a much greater extent than from a paper filter.

Large quantities of liquid are best treated by a different method. The filter is fitted to the end of a tube and immersed in the liquid from above. This type of filter is clogged more slowly, the filtration being accelerated, and a smaller

diameter of the filter giving the same effect as a large Buchner funnel into which the liquid is poured from above.

For purifying air, glass filters are very appropriate. The finer the dust to be retained, the larger the diameter of the sinter to be chosen. As a rule, it is possible to work so that the speed of the air passing through is hardly reduced (see Fig. 7).

Gases intended to be finely distributed in liquids can be passed through glass filters. As a rule, coarse pores are sufficient. This type of filter may be fitted into gas-washing bottles, or used for devices to dissolve oxygen in aquarium water, etc. (Fig. 8).



Fig. 6



Fig. 6a



Fig. 8



Fig. 9



Fig. 10



Fig. 11



Fig. 7

The purification of mercury is greatly simplified by the employment of coarse or medium glass filters. When clogged, they are readily cleansed with nitric acid. On the other hand, the finest filters, with  $5\mu$  pores, do not let mercury pass through under the pressure of 1 atmosphere. Filters of this type may therefore be inserted as safety-valves in vacuum tubings.

Aqueous solutions difficult to purify by reason of their attacking paper filters (*e.g.* cuprous oxide and ammonia, concentrated sodium hydroxide solution, concentrated sulphuric acid, and the like) can be quickly brought into a state of limpid purity by means of  $<7$  glass filters.

Undoubtedly even the very best laboratory glass is open to a certain amount of attack from strong alkalis, though it is practically insoluble in strong acids. The influence of alkalis is of no importance in preparative work in the case of hot dilute alkalis or of concentrated alkalis when cold; but, if hot, it is not advisable to pass concentrated alkalis through glass filters for any length of time.

Up to 60 mm. diameter, laboratory glass filters (type "G") stand the sudden shock of being handled with boiling water. Funnels of larger diameter are preferably not used over 60° C. Funnels of 90 and 120 mm. diameter, intended to be treated with boiling water or boiling acids should be made of Jena Suprax glass (type "S"), this having the smallest co-efficient of heat expansion. But the "S" type is not so resistant to alkalis as the "G" type.

In the case of volatile liquids (ether, petroleum spirit, ammonia solution), it is not practicable to work *in vacuo*. Types of filters adapted for filtering under pressure have been devised to meet this need (Fig. 9).

Apart from the examples given, there are many further ways of employing sintered glass filter discs in chemical work. Thus the use of glass filters (not fused) for large-scale filtering of liquids and of gases, or as diaphragms for electro-chemical work, has hardly begun.

Finally, it is worth mentioning that glass cooling chambers or "cuvettes" for arc-lamp projection apparatus, etc., and colorimeter tubes, have hitherto usually been made by cementing highly polished plate-glass to the rest of the glass or metal apparatus. The principle of fusing the rims only of glass discs without disturbing their structure has now been adopted in the manufacture of colorimeter tubes (Fig. 10) or of cuvettes (Fig. 11), which can then be used with fluids which would otherwise destroy the cement formerly employed. So far, the diameters of these tubes should not be less than 30 mm., and it is not possible to guarantee that tubes closed at both ends with glass plates fused on will be absolutely parallel. The system is therefore unsuitable for polarimeter tubes.

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## Notes.

*The Editor wishes 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.*

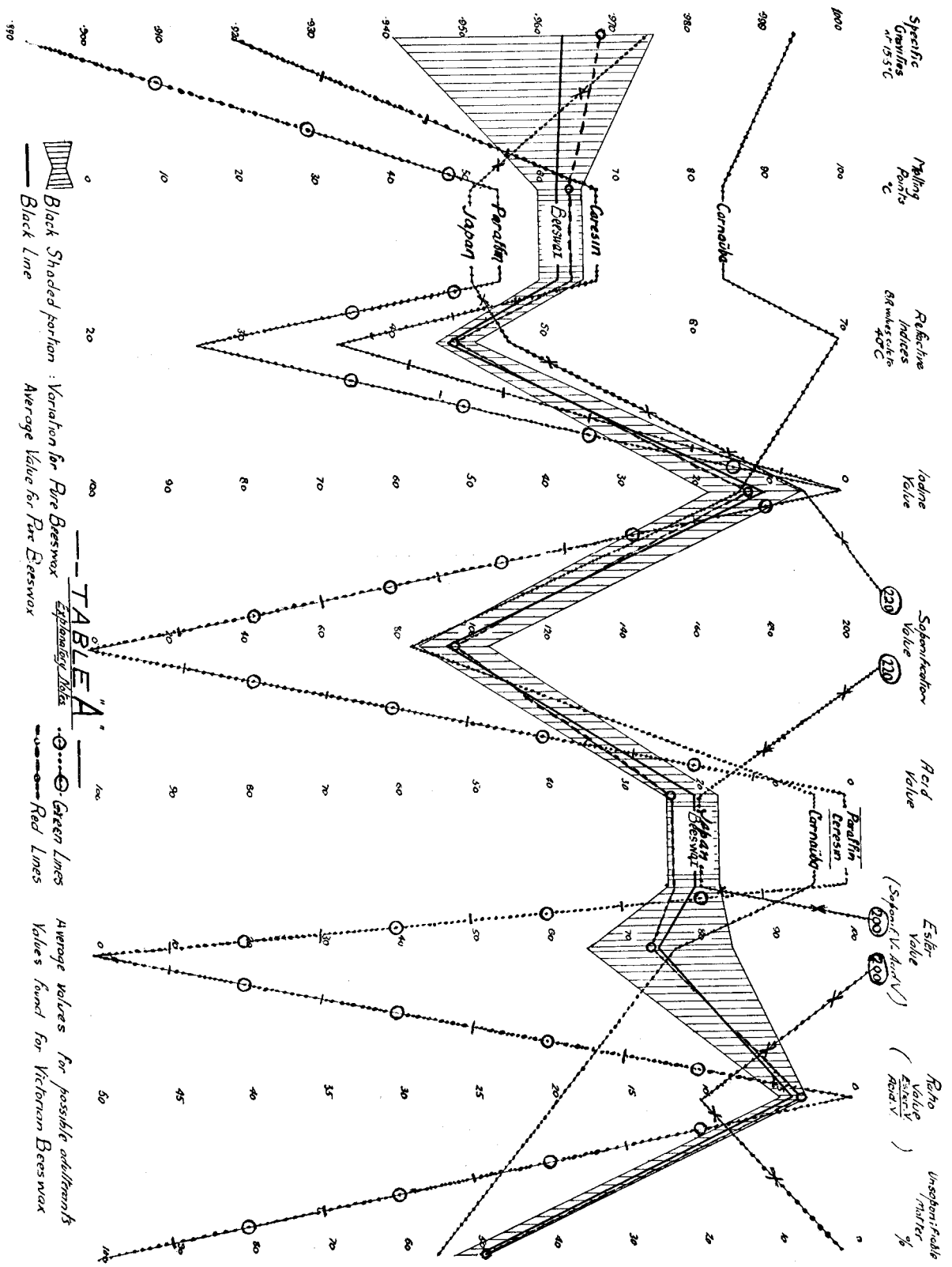
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### THE CARBON ERROR IN THE QUANTITATIVE DEPOSITION OF NICKEL AND IRON FROM COMPLEX OXALATE ELECTROLYTES.

IN reply to Dr. B. S. Evans' remarks on the current density recommended for the electrolysis (ANALYST, 1925, 230), I do not think that 1.0 amp. per sq. dm. will prove too high. W. D. Treadwell (*loc. cit.*) uses 1.0 to 1.5 amps. under parallel conditions, and T. P. Treadwell (*loc. cit.*, p. 80) recommends a current density of 2.0 to 2.8 amps. per sq. dm. for the same type of electrolyte at 60° C.

The anode corrosion was only studied in a few instances, showing that an anodic current density of 12.5 amps. per sq. dm. for 24 hours (Exp. 77) caused a loss of 0.0004 gm. of platinum, whilst a value of 1.0 amp. per sq. dm. for the same length of time (Exp. 78) did not result in any loss in weight of the anode. It will be noticed that the last experiment (78) refers to an electrolyte containing the

# GRAPH FOR ANALYSIS OF BEESWAX.



Black Shaded portion  
Black Line

Variation for Pure Beeswax  
Average Value for Pure Beeswax

Green Lines  
Red Lines

Average values for possible adulterants  
Values found for Victorian Beeswax

TABLE A

prescribed 5 grms. of ammonium chloride. Hence, if the current density be kept sufficiently low, the liability of the anode to be attacked should be eliminated.

It seems to be beyond doubt that the contamination is due to gas reactions catalysed by the deposited metal, as suggested by Dr. Evans and advocated by the writer in the paper mentioned. However, the effect of ammonium chloride on these reactions cannot be explained until it has been further studied. Parallels between the two metals, iron and nickel, cannot be drawn offhand, as the potentials involved may be of importance and should be considered, as was pointed out by Dr. Blum in the discussion of the above-mentioned paper.

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### CONSTANTS OF VICTORIAN BEESWAX: GRAPH FOR THE INVESTIGATION OF BEESWAXES.

I WAS recently called upon to determine the physical and chemical properties of a sample of Victorian beeswax, and to report upon the purity of the wax. After reading through the available literature on the subject, I was forced to conclude that the examination was not so simple, as, at first sight, it appeared.

According to Lewkowitsch (*Technology of Oils, Fats, and Waxes*). Villavecchia (*Applied Analytical Chemistry*), G. Buchner (*ANALYST*, 1893, 18, 233) and others, the acid and saponification values are not sufficiently trustworthy guides as to purity of the wax. Cowan (*Waxcraft*) gives a number of chemical qualitative tests to prove the absence or otherwise of certain adulterants.

The method which I therefore used was to make a graph of the various possible values of constants for pure beeswaxes (Villavecchia, *Applied Analytical Chemistry*), of the known average values for pure beeswax other than Eastern types of waxes, and of the values of the possible adulterants. Upon this graph the various values for the sample in question were plotted in red:—

#### SUMMARY OF RESULTS OF ANALYSIS OF VICTORIAN BEESWAX.

Iodine value (Hübl)	..	..	..	12.14
(Hanus)	..	..	..	12.42
Saponification value	..	..	..	97.14
Acid value	..	..	..	23.31
Unsaponifiable matter	..	..	..	48.66
Specific gravity at 30° C.	..	..	..	0.9478
Specific gravity at 98–99° C. (S.G. bottle)	..	..	..	0.8439
” ” calculated to 15.5° C.	..	..	..	0.9690
Melting point	..	..	..	64.25° C.
Refractive index, $n_D^{75}$	..	..	..	1.4439
Calc. to 40° C. (0.00036 factor per ° C.)	..	..	..	1.4588 = 44.4° (butyrefract).

The advantages of the graph are:—(1) It indicates whether a sample is pure within certain specified limits, or not; and (2) it indicates the nature of any adulterant which may be present, although it does not show the exact proportion of such adulterant.

It will be seen that the graph shows that the sample of Victorian beeswax was pure, and that its characteristics were within the possible limits previously described.

ARTHUR A. WEIR.

## AIR MADE TOXIC BY CHEESE.

MR. R. C. FREDERICK'S paper on "The Investigation of Ventilation Conditions" (ANALYST, 1925, 213) has suggested to me that a recent experience of mine in Auckland City, New Zealand, might be of interest and practical value.

I was called to investigate and advise in connection with an accident on a large steamer. An inspection was being made of the partly filled hold of an overseas steamship by a party of officials, when one of the party fell down unconscious on reaching the cargo, which consisted entirely of crates of New Zealand cheese for shipment to London. He was rescued with difficulty in a state of cyanosis, and received immediate attention from the ship's surgeon, who stated that there had been asphyxiation which had almost proved fatal.

I made a qualitative analysis of the air at once, and found a very large quantity of carbon dioxide present, evidently produced by the cheese. A dairy expert subsequently informed me that *new* cheese in cold storage chambers in New Zealand often produces a dangerous, non-respirable gas, and that before working the cheeses, arrangements have to be made for the elimination of the gas. In this case it was necessary to fix a tube at the lowest part of the hold, to pump out the gas before it was possible to proceed with the loading of the vessel.

ALFRED J. PARKER.

(*Late Govt. Analyst for Auckland*).

## Notes from the Reports of Public Analysts.

*The Editor would be glad to receive the Annual or other Reports of Public Analysts containing matter of interest to the Society. Notes made from such Reports would be submitted to the Publication Committee.*

## CITY OF BIRMINGHAM.

## CITY ANALYST'S REPORT FOR THE FIRST QUARTER, 1925.

DURING the quarter 1413 samples were analysed, of which 1229 were under the Sale of Food and Drugs Acts. Of these 1087 were bought informally (56 adulterated), and 142 under the provisions of the Acts (32 adulterated).

MILK.—Of the 719 samples examined, 10.7 per cent. contained less than 11.5 per cent. of total solids; 77 of the samples were adulterated. Four (informal) of 98 samples of bottled milk contained added water (up to 11 per cent.). The vendor was cautioned, and attributed the presence of the water to a leak in the lining of his pasteurising apparatus.

BUTTER.—Three of 57 samples examined were adulterated, one informal sample containing 21.5 per cent. of water. An informal sample contained boric acid preservative equivalent to 47 grains of boric acid per lb., and for the subsequent formal sample a certificate was given in the following terms:—"I am of opinion that the said sample contained the parts as under: Boric preservative equivalent to 40 grains of boric acid per pound. Observations:—Butter should

not contain more boric preservative than is equivalent to 21 grains per pound." The defendant required that the sample should be sent to the Government Chemist for analysis. This was done, and the report stated that 40.6 grains were present. At the hearing of the case I gave evidence that during the past 5 years 1180 samples of Birmingham butter had been examined, and only 2 had contained more than 21 grains of boric preservative per lb.; 78 per cent. of the samples were free from boric acid, and the average proportion in those containing it was 10 grains per lb. The defence also objected to the form of the certificate, but the magistrates decided that it was a legal form, and fined the defendant, who had sold the butter as he had received it, 10s. and 21s. costs for the Government analysis.

**MARGARINE.**—During 1924 boric acid was present in 96 per cent. of the samples examined. In January, after the publication of the Report of the Departmental Committee on Preservatives, the proportion of samples containing boric acid fell to 17 per cent.; in February there was a slight increase (24 per cent.); but in March 71 per cent. of the samples contained boric preservatives.

**FLOUR.**—Three of 9 samples of flour, and 6 of 15 samples of self-raising flour, contained persulphate or peroxide. Pending the report of the Departmental Committee, all were passed as genuine.

**GREGORY'S POWDER.**—One sample contained about 30 per cent. of magnesium carbonate, instead of 66 per cent. of calcined magnesia as required by the B.P. The defect was probably due to the sample being old and not kept in a properly closed bottle. The vendor was cautioned.

**ALMOND OIL.**—An informal and a formal sample from one vendor consisted of peach-kernel oil. In each case the bottle was labelled "Almond Oil." The vendor was prosecuted under Sec. 6 of the Food and Drugs Act and fined £1. He was also fined £2 under Sec. 27 for wilfully giving a label which falsely described the article sold. This is the first time a prosecution has been taken under this section.

J. F. LIVERSEEGE.

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## METROPOLITAN BOROUGH OF STEPNEY.

### ANNUAL REPORT OF THE BOROUGH ANALYST FOR 1924.

DURING the year 1496 samples were analysed, of which 1456 (959 formal and 497 informal) were taken under the Food and Drugs Acts.

**MILK.**—Of the 895 samples examined, 27 were adulterated. In one case the vendor was not registered as a purveyor of milk, and was fined £1 (Dairies, Cowsheds and Milkshops Order).

**BUTTER.**—Three of 140 samples were adulterated. No boric acid was present in 82.9 per cent. of the samples, and less than 0.1 per cent. in 12.8 per cent.

**MARGARINE.**—Eleven of 145 samples were free from boric acid, 64 contained 0.1 per cent.; 50, 0.2 per cent.; 18, 0.3 per cent.; and 2, 0.4 per cent.

**SPONGE CAKE.**—One (informal) of 12 samples contained 0.09 per cent. of boric acid, and the formal sample contained 0.04 per cent. As butter or margarine may legally contain 0.5 per cent. of boric acid, no objection can be taken to the presence of small quantities of boric acid in cake, unless it can be proved that the boric acid was due to the use of liquid whole egg.

DOUGLAS HENVILLE.



## Legal Notes.

*Under this heading will be published notes on cases in which points of special legal or chemical interest arise. The Editor would be glad to receive particulars of such cases.*

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### LYSOL AND THE MERCHANDISE MARKS ACT.

ON April 1 a trading company was summoned at Bow Street Police Court for selling a bottle of a disinfectant labelled "Lysol," which name, it was alleged, was contrary to the Merchandise Marks Act, and a firm of oil-men was also summoned for having a bottle of this disinfectant exposed for sale in their shop.

Mr. Frampton, for the prosecution, said that lysol was invented by a German, and was patented in this country in 1892. It had always contained approximately 50 per cent. of cresol. In 1914, the trade mark was struck off the list, and it was then open to anyone to manufacture lysol, and, in fact, most of the manufacturing chemists had prepared a substance containing approximately 50 per cent. of cresol, and had sold it under the name of lysol. In 1922 a company was formed to put upon the market a preparation called "Lysol," with the letters "M.S." before it. The label read as follows: "M.S. Lysol. Entirely British Made. Antiseptic and disinfectant. Containing not more than 3 per cent. phenol. Not to be taken internally."

It would doubtless be suggested that "M.S." indicated medium strength, and that the company was entitled to sell as "Lysol" a preparation of any strength they pleased, but the prosecution contended that it should contain about 50 per cent. of cresols, and in this form could only be sold by pharmacists, as it was scheduled as a poison. Analysis of the contents of the sample bottle purchased had shown that this preparation contained only 1 per cent. of phenols, and that it would therefore be useless as a disinfectant.

Mr. H. E. Nicholls gave evidence that he had analysed the contents of a bottle labelled "M.S. Lysol," and had found it to consist of over 90 per cent. of water, with a weak solution of a soluble disinfectant. The amount of tar acids was 1 per cent.

Mr. Neve, for the defence, asked for the witness's report, and pointed out that it showed the sample to contain 94 per cent. of water, 5 per cent. of creosote oil, naphthalene, a soapy solution, and 1 per cent. of tar acids.

This analysis differed considerably from the one they intended to produce, which showed the preparation to contain about 3 per cent. of cresylic acid, 12 per cent. of castor oil, 1 per cent. of soda, and 84 per cent. of water.

Evidence on the lines indicated by counsel was given at the adjourned hearings on April 29, May 16, and June 17, and the case was concluded on July 15.

Mr. Neve then addressed the magistrate on behalf of the defence. The prosecution, he said, had been launched in two ways. First, it was said that lysol meant *ab initio* a solution containing 50 per cent. of tar oils, and ultimately that, if it did not contain 50 per cent. *ab initio*, it had come to mean a fluid containing essentially 50 per cent. of cresols. It was clear, however, that the German who patented the product was entitled to call any solution of tar oils *lysol*, and in the examples given in the patent none of the percentages exceeded 50 per cent., and in one instance there was only 8 per cent. The case for the prosecution was that in this country the product had never contained less than 50 per cent. This might be due to the fact that any proportion exceeding 3 per cent. brought the liquid within the purview of the Poison Act, and that therefore the inventor made

the preparation as concentrated as possible, but he would have been perfectly entitled to make a 3 per cent. solution.

He urged that this prosecution was an attempt on the part of pharmacists to prevent the sale of lysol by grocers. The defendants contended that there had been no false trade description, and that if, in fact, it was held to be false, it was not false, in any material point, since it was specifically called "3 per cent. lysol." The label, "M.S. Lysol," obviously qualified the word, and, as far as the Merchandise Marks Act was concerned, the question of quality did not come in issue at all.

Mr. Frampton, replying, said that the evidence was overwhelming that what had become known as lysol was the 50 per cent. solution, and that this was appreciated by the defendants was shown by the fact that they called their preparation "M.S. Lysol."

The Magistrate, Mr. Graham Campbell, in giving judgment, said that he had come to the conclusion that by usage of the trade the word "lysol" had come to mean a solution which contained 50 per cent. of cresols. Hence he must hold that a false trade description had been applied to the article, and that the article had been sold bearing such false trade description. He did not think the proviso in the Act as to taking reasonable precautions against committing an offence applied in this case. Accordingly he convicted on both summonses.

The defendant company was ordered to pay a fine of 15 guineas on each summons, with 50 guineas costs on the first. The summonses against the retailers were dismissed under the Probation of Offenders Act, on payment of 5 guineas costs.

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#### CALCINED MAGNESIA.

ON July 2 a grocer was summoned at Westborough for selling calcined magnesia not of the nature, substance and quality demanded. The sample contained only 44.53 per cent. of magnesium oxide, instead of 99 per cent., and there was present 50.11 per cent. of magnesium carbonate. The manufacturers, who accepted responsibility for the product, attributed the deficiency in magnesia to the fact that the preparation had been packed in cardboard boxes which were absorbent, so that the magnesia originally present had been converted into magnesium carbonate. The County Analyst (Mr. F. W. Richardson) having agreed that the deterioration might have been caused by the packing, the Bench allowed the summons to be withdrawn on the understanding that the preparation in question should be withdrawn from sale, and that in future the magnesia should be differently packed.

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## Government of Madras.

### REPORT OF THE CHEMICAL EXAMINER FOR THE YEAR 1924.\*

DURING the year 1924 the total number of analyses made was 4125, as against 3973 in the previous year, the increase being due to medico-legal work. This included 234 cases of suspected human poisoning and 417 cases of stains.

\* By Major Clive Newcomb, M.D., F.I.C., Chemical Examiner, G.O. No. 952, P.H., May 7, 1925.

**HUMAN POISONING CASES.**—Of the 234 cases investigated, poison was detected in 100, giving a percentage of detections of 42·7, as against 45·1 in 1923. The number of persons affected in these 100 cases was 189, and of these, 69 died.

The poison most frequently found was opium (19 cases), but arsenic and mercury were almost as common (18 cases each). Aconite, atropine and strychnine were also common poisons. In 1924 in only 37 of the 100 cases was the poison an inorganic one, as against an average of 62·2 per cent. for the last 40 years. This is to be attributed to a decline in the popularity of arsenic as a poison—a decline which started before the Poison Act of 1904 was introduced, and was not markedly accelerated by the introduction of that Act.

There was a larger number of datura cases than usual, and in most of them the poison was given to facilitate theft. The skill with which the drug is introduced into the food of the intended victims, and the nicety with which the dose is judged so that the victim is only rendered unconscious and not killed, support the view that there must be a small gang of professional datura poisoners at work.

Although morphine is stated to be excreted in the urine only in minute traces, it is often possible to obtain the porphyrin reaction with an extract of the urine in an opium poisoning case. The test by itself is not sufficient to prove the presence of opium, but if opium is definitely detected in the stomach, this reaction with an extract from the urine makes it extremely probable that the opium has not only been taken, but that some of it has been absorbed.

Among the cases in which rare poisons were used was a case of attempted suicide with *Abrus precatorius*, the powdered seeds having been mixed with arachis oil. The symptoms noted were vomiting, a feeble pulse, cold clammy skin and sunken eyes with normal pupils. No deep sleep, no tingling of the skin or throat, no convulsions or twitchings, and no delirium were observed.

*Marking-Nut Poisoning.*—Two cases of marking-nut poisoning were investigated, the poison having been applied externally. In one of these cases twigs were imbued with the poison and placed in the bed of a man, and produced severe vesication on the skin. The juice of the marking-nut was detected on the twigs sent for examination.

**ANIMAL POISONING CASES.**—There were 54 cases with 186 articles, as against 40 cases with 141 articles in 1923. This is still below the average for the previous 10 years—79 cases and 254 articles per year. Poison was detected in 22 of the cases (40·7 per cent.). Yellow oleander, or thevetin, its active principle, was again the most common poison, being found in 14 cases. Arsenic, which used to be the most common poison for cattle as for human beings, was detected in only 5 cases.

A case occurred in which aconitine was used as a cattle poison—a very unusual one for the purpose. There were also two cases in which picrotoxin, the active principle of *Cocculus Indicus*, was probably used, as a substance giving reactions resembling those of that poison, was isolated from the poisoned material.

**STAIN CASES.**—During the year 417 cases, with 1716 articles, were investigated. Of these, 386 (1616 articles) were examined for blood only, and it was detected in 336 cases (87 per cent.). In the 31 cases tested for semen, it was detected with certainty (spermatozoa) or with probability (positive Florence test) in 9 cases. The Imperial Serologist at Calcutta tested 1160 specimens of blood stains, and detected human blood in 1083. Of the remainder, 9 were ruminant animal blood, 10 both human and ruminant, 2 non-mammalian, and 1 bird's blood. The experimental blood stains on the laboratory wall, described in last year's report (ANALYST, 1924, 49, 432) could still be just detected as blood, after two years, by

the cyano-hæmoglobin spectrum, although they had been whitewashed over during the year.

In one of the blood cases a pink silk cloth was sent, on which were brown stains which might from their appearance have been blood. The dye of the cloth itself gave a spectrum which, in strong solution, showed complete absorption up to about 580, and, on dilution, gave a rather indefinite band from about 540 to 580, so that the reduced hæmatin, if present, would have been concealed. The stains gave a somewhat indecisive blue with guaiacum and turpentine, but from the absence at any dilution of any indication of a sharper band under the indefinite one given by the dye of the cloth, and from the fact that the hæmin test was repeatedly negative, it was decided that the stains were not blood. The dye answered to the tests given in *Green's Organic Colouring Matters* (p. 188) for No. 449, New Fuchsine.

The importance of a careful search of articles submitted for examination for blood stains was well illustrated by two cases, in each of which a clasp knife that had been carefully cleaned was sent. By taking the knives to pieces, bloodstains were found inside the handles of each, and in one of the cases the stains were very important evidence.

*Florence's Test.*—Further experience of Florence's seminal test has brought increased confidence in its value. In no case in which a stain has been proved to be seminal by the finding of spermatozoa has the test failed, even with some stains that had been kept for 2½ years. In view of the great variety of stains which do not answer to the test, a positive reaction must be regarded as a strong indication that the stain is seminal, even when spermatozoa have not been found.

MISCELLANEOUS MEDICO-LEGAL CASES.—During the year there were 44 cases, with 271 articles, as against 35 cases with 129 articles in 1923, the increase being chiefly due to the large number of bomb cases.

*Bomb Cases.*—In one of these the question was raised whether some balls of lead found inside some unexploded bombs had been made from a lump of lead found in the possession of the accused. Analyses showed that the two leads each contained the same percentage of antimony and traces of iron. This, though not complete proof of a common origin, made this conclusion very probable.

In another case a bomb thrown at a man exploded and killed him instantaneously. The flesh and clothes were stained yellow, suggesting that the bomb might have contained picric acid, but neither gave any reaction for picric acid. On the other hand, both gave the reactions for arsenic, so that the bomb was probably one of the kind, common in the Presidency, containing *inter alia* arsenic sulphide. No arsenic could be detected on iron nails, bits of glass, etc., found embedded in the flesh or near the spot, presumably on account of their smoother and harder surface. It is interesting to note, however, that arsenic can be found on objects hit by the explosion of a bomb containing arsenic sulphide.

GENERAL ANALYSES.—The number of these was 562, a decrease of 126 on the previous year. These included inks, ink powders, sand, carbon tetrachloride, nitric acid, oils, brandies, corn syrup, waters, etc.

*Zinc Vessels for Food.*—Zinc vessels have been used in the gaols of the Bombay Presidency for several years without any cases of zinc poisoning having been diagnosed. Experiments showed, however, that tamarind juice and curry both attacked zinc, if left in contact with it for 24 hours, and zinc could then be detected in the food. It was therefore recommended that zinc vessels should not be used for this purpose.

## Meteorological Office, Air Ministry

### ADVISORY COMMITTEE ON ATMOSPHERIC POLLUTION.

#### REPORT ON OBSERVATIONS IN THE YEAR ENDING MARCH 31ST, 1924.\*

THE STANDARD GAUGE (for collection of deposited matter).—Complete records have been obtained for 34 instruments under 15 authorities. In general, the conditions were not so favourable as those reported on for the previous year, for whereas 23 out of 27 stations then showed a deposit below the average, only 18 out of 31 show an improvement in the current year. Places showing highest and lowest deposits for summer (S) and winter (W) are as follows (results expressed in metric tons per 100 sq. kilometres). *Tar*: (S) Newcastle, 237; Leeds, Headingley, 8; (W) Newcastle, 668; Leeds, Headingley, 18. *Carbonaceous matter*: (S) Newcastle, 2931; Leeds (H), 212; (W) Newcastle, 9846; Leeds, 117. *Insoluble ash*: (S) Newcastle, 5907; Kingston-on-Thames, 179; (W) Newcastle, 8542; Leeds (H), 187. *Volatile salts*: (S) Blackburn, 1850; Leeds (H), 412; (W) Glasgow, 2498; Leeds (H), 403. *Soluble ash*: (S) Blackburn, 5348; Rothampsted, 369; (W) Blackburn, 3470; Rothampsted, 465. *Total deposit*: (S) Rochdale, 21,126; Leeds (H), 1566; (W) Newcastle, 22,598; Leeds (H), 1316.

AUTOMATIC FILTER.—Two additional instruments have been working during the year at Blackburn and Stoke-on-Trent, making a total of 12. Curves for these places are included and are on similar lines to those given in previous reports. The comparison of the records for different days of the week has been made on a new basis, and brings out the fact that there is a general tendency at all stations towards a maximum smoke haze on Wednesdays, with a minimum on Saturdays or Sundays.

THE DARKNESS OF WEDNESDAY, JAN. 23RD, 1924.—The darkness was abnormal in that the amount of impurity registered was not abnormally large, reaching a maximum of 1.92 mgrms. per c.metre at Victoria Street at 10.15 a.m., whereas in thick fogs a record of 6.4 is not unusual. The thick bank of smoke overhead was, no doubt, due to an inversion of the lapse rate. The record taken by the jet dust counter contained many irregular pieces of crystalline material and hygroscopic material was also collected. A counting at 1 p.m. gave 16,250 particles per c.c. generally less than 1 micron in diameter.

THE JET DUST COUNTER.—In August, 1923, it was reported from America that unusual and comparatively large opalescent particles had been encountered in records, and in October apparently identical particles began to be found in records in this country. Their suspected origin is fungoid and their appearance was probably favoured by the wet weather. Dead leaves are regarded as likely to be the chief sources of these mould spores. Crystals found from time to time in the records doubtless owed their source to severe gales and consisted of salt thrown into the air from the sea. Detailed instructions are given in this section for cleaning coverslips, preparing the slides, taking the samples, type of microscope suitable, etc.

SPECTROSCOPIC ANALYSIS OF SUSPENDED IMPURITIES.—So far, results have not been satisfactory, but after further experiments in which the dust is to be deposited directly on the platinum foil more success is expected.

THE SETTLEMENT DUST COUNTER.—This instrument is designed for obtaining a true count of the number of dust particles or bacteria in the air, even when particles are very coarse, and to eliminate all sources of uncertainty. A definite

\* M.O. 270. H.M. Stationery Office, Kingsway, W.C.2. Price 4s. net.

volume of air is enclosed in a vessel of known height, and the dust in a column of this height is allowed to settle on the surface of a cover glass, where it is counted. The air chamber is a plain open-ended metal tube resting on a heavy platform, with a very large diameter in comparison with that of the cover glass, to eliminate any effect produced by the sides of the vessel. Under the axis of the air vessel is a circular hole, and each of a series of 6 cover glasses can be brought under the hole in turn. One half of each cover glass is coated with a 15-20 per cent. solution of Canada balsam in xylene, dried, exposed and the drum containing them placed under the special cover provided which has a disc of blotting paper in the roof. When this is moistened with xylene, liquefaction of the medium occurs, the dust particles adhere, and, on removal of the cover, the Canada balsam re-solidifies. The portion of the cover glass left uncoated permits the particles to be examined dry. The instrument may first be used for grading the dust, *i.e.* ascertaining the time required for settlement of the different sized particles. The time of exposure having been determined, the instrument is taken into the room, the air of which is to be tested, 3 cover glasses are placed in alternate holes, and a hole in the drum adjusted to come beneath that in the bed plate. The air vessel is then removed, the bed plate waved through the air, and the air vessel after being passed two or three times axially through the air is replaced. The vessel is now closed simultaneously with exposure of the first cover glass. This is rendered possible by the design of the apparatus. For the actual counting a square ruled micrometer eye piece with  $\frac{1}{2}$  mm. squares is used.

**DUST IN THE UPPER AIR.**—Mean figures published in the U.S. for particles of dust per c.c. at different altitudes are as follows for October to November:—For altitude 0 ft. particles per c.c., 357; 1000 ft., 308; 2000 ft. 282; 3000 ft., 235; 4000 ft., 157; 5000 ft., 104, up to 10,000 ft., 43.

**EFFECT OF ATMOSPHERIC POLLUTION UPON VISIBILITY.**—Results from the contrast photometer appeared to be more trustworthy than those from the surface brightness photometer, and, moreover, the instrument can be used in daylight. Readings are taken at 100 ft., followed as quickly as possible by further readings at 200 ft. and 250 ft., with final readings at 100 ft. The interpretation of the readings involves a knowledge of what the readings should be at each distance in clear air. As a result of many observations it appears roughly that a loss of 50 per cent. in 50 ft. is caused by the presence of 32,000 particles per c.c., or by 2.6 mgrms. per cb. metre.

D. G. H.

## Ministry of Health.

THE following Circular has been sent to the Clerks of County Councils and Sanitary Authorities (England and Wales):—

### MILK AND DAIRIES (CONSOLIDATION ACT), 1915.

#### Circular 612.

SIR,

I am directed by the Minister of Health to draw the attention of the Council to the Milk and Dairies (Consolidation) Act, 1915, which will come into operation on the 1st September, 1925. Section 21 (1) of the Act provided that it should come into operation on such date, not being later than the expiration of one year after the termination of the war, as the Local Government Board might by order appoint. Section 1 of the Milk and Dairies (Amendment) Act, 1922, enacted that the 1915 Act, notwithstanding anything contained therein, should not come into operation before the 1st September, 1925. Although it was the evident intention of the 1922

Act that the 1915 Act should come into operation on the date mentioned, the Minister is advised that it is not certain that this is effected automatically by the Act itself. He has therefore deemed it advisable in order to remove any possible doubt, to make an Order formally appointing the 1st September, 1925, as the date of commencement of the Act. A copy of this Order, which is entitled the Milk and Dairies (Consolidation) Act, 1915 (Commencement of Operation), Order, 1925, is enclosed herewith.

The 1915 Act repeals and re-enacts a number of provisions contained in the Contagious Diseases (Animals) Acts and the Sale of Food and Drugs Acts with regard to Milk and Dairies. It also reproduces a number of amendments and new provisions which were contained in the Milk and Dairies Act, 1914, the operation of which was deferred.

Sections 1 and 2 of the 1915 Act include provisions for the making and enforcement of Milk and Dairies Orders, extending the list of purposes for which similar Orders could be made under the Contagious Diseases (Animals) Act, 1878. It is proposed as soon as possible to make an Order under the new powers, but in pursuance of the proviso to Section 21 (3), the Dairies, Cowsheds and Milk-shops Orders of 1885, 1886, and 1899, and the Regulations made by Local Authorities under Article 13 of the Order of 1885 will, until altered or revoked, continue in force as if made under the new Act.

Sections 3, 4 and 5 and the First Schedule contain provisions similar in effect to those which are contained in a number of Local Acts for stopping the supply of milk which is likely to cause tuberculosis. In the Local Acts the power of stopping the supply is given to the Local Authority for the consuming area and the prohibition only applies to that area. Under the General Act the duty of enforcement is placed on the Council of the County or County Borough in which the cows are kept, and any Order made by them will prohibit the sale of the affected milk in any area. Section 4 requires the Medical Officer of Health of the County or County Borough to make the necessary investigations on receipt of a notice from any other Medical Officer of Health. Section 21 (3) provides that as from the expiration of one year after the commencement of the Act the Local Act provisions shall be repealed.

The Minister of Agriculture and Fisheries has made an Order (the Tuberculosis Order of 1925) providing for the slaughter of bovine animals affected with certain specified forms of tuberculosis and for the payment of compensation in respect of animals so slaughtered. The Order will come into operation on the same day as the Act and it will be the duty of the Local Authority, when in the exercise of their powers under the Act they discover the presence in a herd of an animal to which the Order applies, to cause it to be slaughtered in pursuance of the Order, or if they are not themselves the Authority for the purposes of the Diseases of Animals Acts, to report the matter to that Authority for the appropriate action. Further information as to the Tuberculosis Order is contained in the Circular Letter issued by the Ministry of Agriculture and Fisheries under the Reference No. T.A. 19848/C.L.

Sections 6 and 7 re-enact provisions contained in the Sale of Food and Drugs Act, 1899.

Section 8, in conjunction with Section 14, enlarges the power of the Officers of the Local Authority to take samples of milk, and such samples may under the Act be taken at any time before the milk is delivered to the consumer. Except by the direction of the Minister, samples may only be taken in the area for which the Officer acts, but an Authorised Officer of one Authority may by notice require the Medical Officer or other Authorised Officer of another Authority, being a Sale of Food and Drugs Acts Authority, to take samples of milk within the area of his Authority. Where such a notice is given, the Authority whose officer requires samples to be taken will be liable to defray the expenses incurred, and for the purposes of the Sale of Food and Drugs Acts the sample will be deemed to have been taken within the area of the officer giving the notice.

Section 9 in conjunction with the Third Schedule amends the provisions of the Sale of Food and Drugs Acts with regard to the warranty defence. Where such a defence is pleaded by a purveyor of milk a sample from a corresponding milking must be taken in the course of transit or delivery to the purveyor, and if the owner of the cows so requests, a further sample must be taken at the dairy at which the cows are kept. The warranty defence will not be available where the sample in respect of which the proceedings are taken is a mixture of milk obtained from more than one seller or consignor. Power is also given to the Local Authority of the District in which the first sample was taken, instead of or in addition to taking proceedings against the purveyor, to take proceedings against the seller or consignor.

Attention may also be drawn to the definition of the expression "dairy" in Section 19 (1) of the Act. It will be observed that the expression does not include a shop from which milk is not supplied otherwise than in the properly closed and unopened receptacles in which it was delivered to the shop.

I am, Sir, your obedient servant,

R. B. CROSS (Assistant Secretary).

July 31, 1925.

**PRESERVATIVES, &c., IN FOOD.**

*The Public Health (Preservatives, &c., in Food) Regulations, 1925, dated August 4, 1925, made by the Minister of Health.*

**STATUTORY RULES AND ORDERS, 1925, 775.\***

69755.

The Minister of Health, in the exercise of the powers conferred upon him by the Public Health Act, 1875,(a) the Public Health (London) Act, 1891,(b) the Public Health Act, 1896,(c) the Public Health (Regulations as to Food) Act, 1907,(d) and the Butter and Margarine Act, 1907,(e) and of every other power enabling him in that behalf, hereby makes the following Regulations, with the consent of the Commissioners of Customs and Excise, so far as they apply to the Officers of Customs and Excise, that is to say:—

**PART I.***General.*

1.—These Regulations may be cited as the Public Health (Preservatives, &c., in Food) Regulations, 1925, and shall come into operation on the 1st day of January, 1927:

Provided that—

- (i) the Regulations shall come into operation on the 1st day of January, 1928, so far as they relate to butter and cream and to the revocation of such of the provisions of the Public Health (Milk and Cream) Regulations, 1912,(f) and the Public Health (Milk and Cream) Regulations, 1912, Amendment Order, 1917,(g) as relate to cream; and
- (ii) so far as the Regulations prohibit the sale of an article of food containing any preservative which is necessarily introduced by the use in its preparation of preserved bacon, ham, margarine or butter, they shall come into operation on the 1st day of July, 1927, in the case of bacon, ham and margarine, and the 1st day of July, 1928, in the case of butter.

2.—(1) In these Regulations unless the context otherwise requires—

“The Minister” means the Minister of Health;

“Local Authority” means any local authority authorised to appoint an analyst for the purposes of the Sale of Food and Drugs Acts, 1875 to 1907, and “public analyst” means an analyst so appointed;

“Officer of Customs and Excise” includes any person acting under the authority of the Commissioners of His Majesty’s Customs and Excise;

“Food” means food or drink intended for human consumption;

“Cream” means that portion of milk rich in milk-fat which has been separated by skimming or otherwise and is intended for human consumption;

“Preservative” means any substance which is capable of inhibiting, retarding or arresting the process of fermentation, acidification, or other decomposition of food or of masking any of the evidences of putrefaction; but does not include common salt (sodium chloride), saltpetre (sodium or potassium nitrate), sugars, acetic acid or vinegar, alcohol or potable spirits, herbs, hop extract, spices and essential oils used for flavouring purposes or any substance added to food by the process of curing known as smoking;

“Thickening substance” means sucrate of lime, gelatine, starch paste or any other substance, which when added to cream is capable of increasing its viscosity, but does not include cane or beet sugar;

“Sulphur dioxide” includes sulphites, and “benzoic acid” includes benzoates;

“Sell” includes expose or offer for sale or deposit in any place for the purposes of sale, and “sale” shall be construed accordingly;

“Importer” includes any person who, whether as owner, consignor or consignee, agent or broker, is in possession of or in anywise entitled to the custody or control of any article of food brought from a place situate outside Great Britain, Ireland, the Channel Islands, and the Isle of Man; and “import” shall be construed accordingly;

(2) Percentages shall be calculated by weight.

(3) Sulphites shall be calculated as sulphur dioxide (SO<sub>2</sub>) and benzoates as benzoic acid (C<sub>6</sub>H<sub>5</sub>COOH).

(4) The Interpretation Act, 1889,(h) applies to the interpretation of these Regulations as it applies to the interpretation of an Act of Parliament.

(a) 38-9 V. c. 55.

(e) 59-60 V. c. 20.

(e) 7 E. 7. c. 21.

(b) 54-5 V. c. 76.

(d) 7 E. 7. c. 32.

(f) S.R. & O. 1912, No. 1152.

(g) S.R. & O. 1917, No. 141.

(h) 52-3 V. c. 63.



## PART II.

*Sale of Articles of Food and Preservatives.*

3.—The Local Authority and every officer of a Local Authority authorised in writing by the Authority shall enforce and execute this Part of these Regulations, and for this purpose shall make such enquiries and take such other steps as may seem to them or him to be necessary for securing the due observance of this Part of the Regulations in the district of the local authority.

4.—(1) No person shall manufacture for sale or sell any article of food which contains any added preservative or any of the colouring matters specified in Part II. of the First Schedule to these Regulations:

Provided that—

- (i) any article of food specified in Part I. of the said Schedule may contain preservative of the nature and in the proportion therein specified;
- (ii) where an article of food specified in Part I. of the said Schedule is used in the preparation of any other article of food, the latter article may contain any preservative necessarily introduced by the use of the former article, but the total proportion of any one preservative contained in any article of food specified in that Part of the Schedule shall not exceed the proportion therein specified.

(2) A person who sells any of the articles of food specified in paragraph 1 of the Second Schedule to these Regulations which contains any preservative shall cause such article at the time when it is exposed or offered for sale by retail or delivered to any purchaser, broker or agent to be labelled in accordance with the Rules set out in that Schedule:

Provided that—

- (i) this provision shall not apply where the article of food is exposed or offered for sale by retail or delivered to a customer in a hotel, restaurant or other such place for consumption on the premises; and
  - (ii) when the article is exposed or offered for sale by retail it shall be a sufficient compliance with this requirement if a notice to the effect that the article contains preservative is exhibited in a conspicuous position so as to be easily readable by a purchaser.
- (3) No person shall sell cream which contains any thickening substance.

5.—(1) No person shall sell any article which is recommended in any mark or label placed thereon or on its receptacle or container for use as a preservative of, or colouring matter for, any article of food or is described or referred to in any such mark or label in terms likely to lead to its being so used,—

- (i) if such use would be contrary to these Regulations; or
- (ii) if in the case of a preservative, it is not labelled in accordance with the Rules set out in the Second Schedule to these Regulations.

(2) No person shall on or in connection with the sale of any article or in any advertisement, circular or notice relating thereto recommend it for use as a preservative of, or colouring matter for, any article of food, or describe or refer to it in terms likely to lead to its being so used, if such use would be contrary to these Regulations.

(3) No person shall sell any article which is recommended in any such mark or label as aforesaid for use as a thickening substance for cream or is described or referred to in any such mark or label in terms likely to lead to its being so used, and no person shall on or in connection with the sale of any article or in any advertisement, circular or notice relating thereto recommend it for use as a thickening substance for cream or describe or refer to it in terms likely to lead to its being so used.

6.—(1) Any officer authorised by the Minister and any officer of the Local Authority acting in the execution of these Regulations shall have power to enter at all reasonable times any premises where articles to which these Regulations apply are prepared, packed, labelled or stored.

(2) The officer may take samples of any such article or of any substance used or capable of being used in the preparation of any such article and of any labels designed to be affixed to any such article or to any package or other receptacle containing such article, but shall if so required make reasonable payment for any samples so taken.

(3) Where a sample is taken of an article to which these Regulations apply, the Sale of Food and Drugs Acts, 1875 to 1907, shall apply as if the officer were an officer authorised to procure samples thereunder; and where an analysis is required for the purposes of these Regulations, the provisions of Section 14 of the Sale of Food and Drugs Act, 1875,<sup>(a)</sup> as amended by Section 13 of the Sale of Food and Drugs Act, 1890,<sup>(b)</sup> shall apply.

7.—Where it appears to any authority or officer whose duty it is to enforce these Regulations that an article has been sold within the district of the authority contrary to the provisions of Article 4 or 5 of these Regulations, the authority or officer may, instead of or in addition to taking proceedings against the seller, take proceedings against any previous seller of the article notwithstanding that the sale by such previous seller took place outside the district of the authority, and for the purpose of any such proceedings the sale by the previous seller shall be deemed to have taken place within the district of the authority and the proceedings may be taken either before a Court having jurisdiction within that district or before a Court having jurisdiction in the place where the sale actually took place.

### PART III.

#### *Importation of Articles of Food.*

8.—(1) Subject to any directions given by the Commissioners of Customs and Excise after consultation with the Minister, the Officers of Customs and Excise shall have power to enforce and execute this Part of these Regulations and may take such samples as may be necessary of consignments of imported articles to which these Regulations apply.

(2) Where an Officer of Customs and Excise takes a sample for the purpose of analysis he shall send the sample or a portion thereof to the Government Chemist, and either the officer or the Government Chemist shall send a portion of the sample to the importer.

9.—(1) The following authorities and any officers authorised by them in writing shall also have power to enforce and execute this Part of these Regulations, namely:—

- (a) Where the article of food is landed from a ship or aircraft in a place which is not within the jurisdiction of a Port Sanitary Authority, or where the article is imported in a vehicle and the Customs examination of that vehicle is deferred with the consent of the Commissioners of Customs and Excise until the vehicle reaches a place outside such jurisdiction, the Council of the Borough (including the City of London and a Metropolitan Borough) or Urban or Rural District in which such place is situated.

(b) In every other case, the Port Sanitary Authority.

(2) Every officer authorised as aforesaid may take such samples as may be necessary of consignments of imported articles to which these Regulations apply, and where he takes a sample for the purpose of analysis he shall send the sample or a portion thereof to a public analyst and either the officer or the analyst shall send a portion of the sample to the importer.

(3) Where the duties of an Officer of Customs and Excise with regard to the examination of a cargo or consignment comprising an article of food have not been wholly discharged, a sample of that article shall not be taken without his consent, but every officer of Customs and Excise shall afford such facilities as the circumstances require for the taking of samples in pursuance of this Article.

10.—If in any case the Commissioners of Customs and Excise or a Port Sanitary Authority or other authority executing this Part of these Regulations are of opinion that an offence against this Part of these Regulations has been committed, they shall communicate to the Minister for his information the name of the importer and such other facts as they may possess or may obtain as to the destination of the consignment.

11.—(1) No person shall import into England or Wales any article of food intended for sale which contains any added preservative or any of the colouring matters specified in Part II. of the First Schedule to these Regulations:

Provided that—

- (i) any article of food specified in Part I. of the said Schedule may contain preservative of the nature and in the proportion therein specified;
- (ii) where an article of food specified in Part I. of the said Schedule is used in the preparation of any other article of food, the latter article may contain any preservative necessarily introduced by the use of the former article, but the total proportion of any one preservative contained in any article of food specified in that Part of the Schedule shall not exceed the proportion therein specified.

(2) No person shall import into England or Wales any cream intended for sale which contains any thickening substance.

### PART IV.

#### *Miscellaneous.*

12.—The provisions of these Regulations with respect to prohibiting any preservative or colouring matter or thickening substance in articles of food and requiring the labelling of certain articles of food and of articles sold as preservatives shall not apply in the case of any article which is intended to be exported or re-exported, or in the case of butter intended for use as ships' stores.

13.—(1) In any proceedings under these Regulations the certificate of the Government Chemist or the public analyst, as the case may be, of the result of the chemical examination of a sample shall be sufficient evidence of the facts therein stated, unless the defendant requires that the person who made the examination be called as a witness.

(2) In any proceedings under these Regulations, where the fact that any article has been dealt with contrary to these Regulations has been proved, if the respondent desires to reply upon the exceptions or provisions contained in these Regulations with reference to such article being sold for consumption on the premises or being intended for export or re-export or for use as ships' stores it shall be incumbent upon him to prove that the article was so sold or was intended for export or re-export or for use as ships' stores.

14.—A person shall, if so required, give to any officer of Customs and Excise or of any local authority who is acting in the execution of these Regulations all reasonable assistance in his power, and shall, in relation to anything within his knowledge, furnish any such officer with all information which he may reasonably require for the purposes of these Regulations, including information as to the persons from whom or places from which any article to which these Regulations apply has been obtained and to whom and to which it has been consigned or otherwise disposed of.

15.—The Public Health (Milk and Cream) Regulations, 1912, the Public Health (Milk and Cream) Regulations, 1912, Amendment Order, 1917, and so much of the Public Health (Imported Food) Regulations, 1925,(a) as relates to paragraph (f) of the First Schedule thereto are hereby revoked, but without prejudice to any proceedings begun or other action taken in pursuance of any of those Regulations.

*The First Schedule.*

PART I.—ARTICLES OF FOOD WHICH MAY CONTAIN PRESERVATIVE AND NATURE AND PROPORTION OF PRESERVATIVE IN EACH CASE:—

The articles of food specified in the first column of the following table may contain the preservative specified in the second column in proportions not exceeding the number of parts (estimated by weight) per million specified in the third column:—

Food.	Preservative.	Parts per Million.
1. Sausages and sausage meat containing raw meat, cereals and condiments.	Sulphur dioxide ..	450
2. Fruit and fruit pulp, not dried:		
(a) Strawberries and raspberries .. ..	Do. ..	2,000
(b) Other fruit .. .. .	Do. ..	1,500
3. Dried fruit:		
(a) Apricots, peaches, nectarines, apples and pears	Do. ..	2,000
(b) Raisins and sultanas .. .. .	Do. ..	750
4. Unfermented grape juice and non-alcoholic wine made from such grape juice if labelled in accordance with the rules contained in the Second Schedule to these Regulations.	Benzoic acid ..	2,000
5. Other non-alcoholic wines, cordials and fruit juices, sweetened or unsweetened.	{ Either Sulphur dioxide ..	350
	or Benzoic acid ..	600
6. Jam (including fruit jelly prepared in the way in which jam is prepared, but not including marmalade made from citrous fruits).	Sulphur dioxide ..	40
7. Candied peel .. .. .	Do. ..	100
8. Sugar (including solid glucose) .. .. .	Do. ..	70
9. Corn syrup (liquid glucose) .. .. .	Do. ..	450
10. Gelatine .. .. .	Do. ..	1,000
11. Beer .. .. .	Do. ..	70
12. Cider .. .. .	Do. ..	200
13. Alcoholic wines .. .. .	Do. ..	450
14. Sweetened mineral waters .. .. .	{ Either Sulphur dioxide ..	70
	or Benzoic acid ..	120
15. Brewed ginger beer .. .. .	Benzoic acid ..	120
16. Coffee extract .. .. .	Do. ..	450
17. Pickles and sauces made from fruit or vegetables ..	Do. ..	250

PART II.—COLOURING MATTERS WHICH MAY NOT BE ADDED TO ARTICLES OF FOOD.

1. *Metallic Colouring Matters.*

Compounds of any of the following metals:—

Antimony,	Cadmium,	Copper,	Lead,
Arsenic,	Chromium,	Mercury,	Zinc.

2. *Vegetable Colouring Matter.*

Gamboge.

3. *Coal Tar Colours.*

Number in Colour Index of Society of Dyers and Colourists, 1924.	Name.	Synonyms.
7	Picric Acid	Carbazotic Acid
8	Victoria Yellow	Saffron Substitute; Dinitrocresol.
9	Manchester Yellow.	Naphthol Yellow; Martius Yellow.
12	Aurantia	Imperial Yellow.
724	Aurine	Rosolic Acid; Yellow Coralline.

*The Second Schedule.*

LABELLING OF ARTICLES OF FOOD CONTAINING PRESERVATIVE AND OF PRESERVATIVES.

1.—The articles of food containing preservative to which the Rules as to labelling set out in this Schedule apply are sausages, sausage-meat, coffee extract, pickles and sauces, and (where the proportion of benzoic acid exceeds 600 parts per million) grape juice and wine.

2.—(1) Where any of the said articles of food contains preservative it shall bear a label on which is printed the following declaration or such other declaration substantially to the like effect as may be allowed by the Minister:—

(a) CONTAIN(S)  
PRESERVATIVE.

(2) The declaration shall be completed by inserting at (a) the word "This" or "These," followed by the name of the food as used in paragraph 1 of this Schedule.

(3) In the case of grape juice or wine to which these Rules apply there shall be added to the declaration the words "and is not intended for use as a beverage."

3.—(1) An article sold as a preservative shall bear a label on which is printed the following declaration or such other declaration substantially to the like effect as may be allowed by the Minister:—

THIS PRESERVATIVE CONTAINS  
(a) PER CENT. OF SULPHUR DIOXIDE.

(2) Where the article contains benzoic acid the words "Benzoic Acid" shall be substituted for the words "Sulphur Dioxide."

(3) The declaration shall be completed by inserting at (a) in words and figures, excluding fractions (e.g. "seventy (70)") the true percentage of the sulphur dioxide or benzoic acid present in the article.

4.—The prescribed declaration shall in each case be printed in dark block type upon a light coloured ground within a surrounding line and no other matter shall be printed within such surrounding line. The type used shall be not less than one-eighth of an inch in height, or, in the case of grape juice or wine to which these Rules apply, one-sixteenth of an inch in height.

5.—The label shall be securely affixed to the article or be part of or securely affixed to the wrapper or container, and in any case shall be so placed as to be clearly visible. If the article bears a label containing the name, trade mark, or design representing the brand of the article or the name and address of the manufacturer or dealer the prescribed declaration shall be printed as part of such label.\*

6.—No comment on or explanation of the prescribed declaration (other than any direction as to use in the case of a preservative) shall be placed on the label or on the wrapper or container.

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Given under the Official Seal of the Minister of Health this Fourth day of August in the year One thousand nine hundred and twenty-five.

(L.S.)

H. W. S. FRANCIS, .

*Assistant Secretary, Ministry of Health.*

The Commissioners of Customs and Excise hereby consent to the foregoing Regulations so far as they apply to the officer of Customs and Excise:

A. J. DYKE.  
W. YOUNG.

*Note.*—The Public Health Act, 1896, provides by sub-section (3) of Section 1 that if any person wilfully neglects or refuses to obey or carry out, or obstructs the execution of any regulations made under any of the enactments mentioned in that Act, he shall be liable to a penalty not exceeding £100, and, in the case of a continuing offence, to a further penalty not exceeding £50 for every day during which the offence continues.

The power of making regulations under the Public Health Act, 1896, and the enactments mentioned in that Act, is enlarged by the Public Health (Regulations as to Food) Act, 1907.

The Butter and Margarine Act, 1907, provides by sub-section (3) of Section 7 that any person who manufactures, sells, or exposes or offers for sale or has in his possession for the purpose of sale, any butter, margarine or milk-blended butter which contains a preservative prohibited by a Regulation under the Section or an amount of a preservative in excess of the limit allowed by any such Regulation shall be guilty of an offence under the Act. Under Section 11 of the Act any person guilty of an offence under the Act is liable for a first offence to a fine not exceeding £20 and for a second offence to a fine not exceeding £50, and for a third or any subsequent offence to a fine not exceeding £100, and in cases where imprisonment can be inflicted under Section 17 of the Sale of Food and Drugs Act, 1899, to such imprisonment as is authorised by that Section.

By Section 5 of the Butter and Margarine Act, 1907, the importation of any butter, margarine, or milk-blended butter which contains a preservative prohibited by any Regulation made under the Act, or an amount of a preservative in excess of the limit allowed by any such Regulation, is made an offence under Section 1 of the Sale of Food and Drugs Act, 1899.

\* In the case of imported food, the provisions of section 16 of the Merchandise Marks Act, 1887 (50-1 V. c. 28), must also be complied with if the label bears the name or trade mark of a dealer or merchant in the United Kingdom.

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## PUBLIC HEALTH (PRESERVATIVES, &c., IN FOOD) REGULATIONS, 1925. Circular 606.\*

SIR,

I am directed by the Minister of Health to forward for the information of the Authority a copy of the Public Health (Preservatives, &c., in Food) Regulations, 1925, which are based on the recommendations of the recent Departmental Committee on the Use of Preservatives and Colouring Matters in Food.

\* H.M. Stationery Office. Price Id. net.

The Regulations provide for the prohibition of the importation and sale of articles of food to which preservatives and other specified substances have been added. The provisions as to importation contained in Part III. of the Regulations will be enforced by the Officers of Customs and Excise and by the Port and other Sanitary Authorities responsible for the administration of the Public Health (Imported Food) Regulations, 1925. The Regulations in terms give co-ordinate jurisdiction to the Officers of Customs and Excise and to the Local Authorities and their officers, but it has been arranged with the Commissioners of Customs and Excise that so far as meat and fish and their products are concerned, the enforcement will normally be left to Local Authorities and their officers, and that the Officers of Customs and Excise will normally enforce the Regulations so far as they apply to other articles of food. Local Authorities are not precluded from taking action with regard to such other articles, but in order to avoid any duplication it is desirable that wherever they propose to take samples of any such article or to initiate proceedings in connection with its importation they should notify the local Officer of Customs and Excise. Under Article 9 (3) an officer of a Local Authority must in certain circumstances obtain the consent of the Officer of Customs and Excise before taking a sample.

One of the recommendations of the Departmental Committee was, that any prohibitions or limitations imposed by Regulations should bind the Courts in proceedings taken under the Sale of Food and Drugs Acts. The Committee went on to say:—

“If this were done, traders and the public generally would know what was permissible and what was not, and there would be no conflict of expert evidence on the question whether the amount of preservative or colouring matter was or was not injurious to health. The only point at issue would normally be whether the preservative or colouring matter found in the food, or the amount of it, was in contravention of the Regulations. A change in the law in this direction would, we feel sure, be appreciated both by Local Authorities and by traders.”

The Minister is entirely in agreement with the view of the Committee, but it has not been practicable up to the present time to introduce legislation to give effect to this recommendation. The Minister commends the matter, however, to the consideration of Local Authorities and suggests that proceedings should not be taken under the Sale of Food and Drugs Acts in respect of the addition of preservatives to food except where such addition would be contrary to the provisions of the Regulations. In this connection Local Authorities will no doubt have regard to the fact that, in conformity with the recommendation of the Committee, the Regulations have been framed so as to allow time for the adjustment of methods and processes, and the clearance of existing stocks, before they come into operation.

Representations have been made to the Minister that a Local Authority, before instituting proceedings under the Regulations, should give the person concerned an opportunity of furnishing an explanation. This suggestion has been made mainly on the ground that, especially during the early period of operation of the Regulations, difficulties may occur which would be satisfactorily cleared up by administrative action and would not justify the institution of legal proceedings. The Minister is in general agreement with the suggestion, but he thinks that the matter is one that can properly be left to the discretion of Local Authorities and he has, therefore, decided not to include in the Regulations any specific provision on this point.

Representations have also been made that a retailer should be entitled, as in the case of the Sale of Food and Drugs Acts, to plead the defence of warranty. The Minister feels that the proposal is equitable in principle, but he is advised that, in view of the statutory powers under which the Regulations are made, it is not possible to include a suitable provision to give effect to it in the Regulations. Attention may, however, be drawn to Article 7 which empowers a Local Authority instead of, or in addition to, taking proceedings against a retailer, to take proceedings against the manufacturer or wholesaler by whom the article was previously sold. It is suggested that this provision might be used with advantage in many cases where an article of food is sold in a sealed container bearing the name and address of the manufacturer or of the wholesale dealer responsible for its distribution. In connection with this matter reference may be made to the terms of Article 14 which enables the officers of the Local Authority to make any necessary enquiries as to the origin of an article to which the Regulations apply.

I am, Sir, your obedient servant.

The Town Clerk or,  
The Clerk to the Council or,  
The Clerk to the Port Sanitary Authority.

R. B. CROSS,  
*Assistant Secretary.*

## Dangerous Drugs Bill.

AN Act to amend the Dangerous Drugs Acts, 1920 and 1923, so as to enable effect to be given to the Convention signed at Geneva on February 19, 1925 (*cf.* ANALYST, 1925, 188), was introduced into the House of Lords on July 29, and was read a second time without a division. It was passed in the House of Commons on August 4 and 5, almost without discussion. This Act, which together with the former Acts, may be cited as the Dangerous Drugs Acts, 1920 to 1925, enacts:—

1.—(1) Part I. of the Dangerous Drugs Act, 1920 (which restricts the importation and exportation of, and gives power to regulate dealings in, raw opium), shall, as amended by this Act, apply to coca leaves, Indian hemp, and resins obtained from Indian hemp and all preparations of which such resins form the base, as it applies to raw opium.

(2) In this Act

The expression "coca leaves" means the leaves of any plant of the genus of the *Erythroxylaceae*, from which cocaine can be extracted either directly or by chemical transformation. The expression "Indian hemp" means the dried flowering or fruiting tops of the pistillate plant known as *Cannabis sativa*, from which the resin has not been extracted, by whatever name such tops are called.

2.—The words "and except in packages marked in the prescribed manner with an indication of the contents thereof" in subsection (1) of section 2 of the Dangerous Drugs Act, 1920 (which restricts the exportation of raw opium), are hereby repealed.

3.—The following shall be substituted for subsection (1) of section 8 of the Dangerous Drugs Act, 1920 (which defines the drugs to which Part III. of that Act applies):—

"(1) The drugs to which this part of this Act applies are morphine, cocaine (including synthetic cocaine), ecgonine, diacetylmorphine (commonly known as diamorphine or heroin), and their respective salts, medicinal opium, and any extract or tincture of Indian hemp, and any preparation, admixture, extract or other substance containing any proportion of diacetylmorphine or containing not less than one-fifth per cent. of morphine or one-tenth per cent. of cocaine or ecgonine.

"For the purpose of the foregoing provision the expression 'ecgonine' means laevo-ecgonine, and includes any derivatives of ecgonine from which it may be recovered industrially, and the percentage in the case of morphine shall be calculated as in respect of anhydrous morphine."

4.—(1) For the purposes of the Dangerous Drugs Act, 1920 and 1923, and this Act, the expression "medicinal opium" means raw opium which has undergone the processes necessary to adapt it for medicinal use in accordance with the requirements of the British Pharmacopœia, whether it is in the form of powder or is granulated or is in any other form, and whether it is or is not mixed with neutral substances.

(2) The definition of medicinal opium in subsection (1) of section 15 of the Dangerous Drugs Act, 1920, is hereby repealed.

Sections 5 and 6 refer to the relationship of the Act to the Geneva Convention, and Section 7 deals with the application of the Act to Northern Ireland, and the date of its operation (to be decided by Order in Council). (*Cf.* ANALYST, 1921, 46, 304.)

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## ABSTRACTS OF PAPERS PUBLISHED IN OTHER JOURNALS.

### Food and Drugs Analysis.

**Seeds of *Citrullus vulgaris* as a Source of Oil.** (*Bull. Imp. Inst.*, 1925, 23, 149–157.)—The water melon (*Citrullus vulgaris*) is widely distributed in all warm countries. The figures given below for oil from Gold Coast seed (Neele seed) probably represents oil from 3 different varieties, as the seeds showed certain

differences although the oils were practically identical. The Kogai seed examined was from Sierra Leone and the Guna seed from Nigeria.

	Neele seed oil.	Kogai seed oil.	Guna seed oil.
Oil per cent. on dry seed	36.8- 48.4	47.8	48.1
Sp. gr. at 15°/15°	0.9230- 0.9236	0.9218	0.9234
Acid value	1.3- 3.2	17.8	3.8
$n_D^{40}$ ° C.	1.467	1.4645	1.465
Saponification value	191.3-195.1	193.7	190.1
Iodine value (Hübl, 17 hrs.)	119.2-124.3	117.5	115.5
Unsaponifiable matter, per cent.	0.7- 0.8	1.1	0.9
"Titer" test	29.2- 32.7	33.4	—

The meals left after removal of the oil vary in composition. Whilst all are rich in protein, Kogai meal yields most (58.8 per cent.), Neele meal about 30 per cent., and Guna meal is intermediate (41 per cent.), calculated in each case to 7.0 per cent. of fat and 10 per cent. moisture. Fibre values are high for Neele (29-39 per cent.), and Guna meals (30 per cent. on the same basis), whilst Kogai meal only gave 11.4 per cent. The oils may be classed in the semi-drying class; the meals were free from cyanogenetic glucosides and are likely to form valuable feeding stuffs.

D. G. H.

**Measurement of the Susceptibility of Fats to Oxidation.** **G. R. Greenbank and G. E. Holm.** (*Ind. Eng. Chem.*, 1925, **17**, 625.)—The fats are placed in flasks which are filled with oxygen and placed in a constant-temperature oven at 70° C.; each flask is connected with a mercury manometer. During temperature adjustment the pressures are regulated by means of 3-way taps inserted in the tubes. The manometers are connected by platinum tipped copper wires with a clock-recording device. As soon as absorption begins in any one flask, the mercury is drawn up the limb of the manometer tube, electrical connection is broken, and the record no longer operates.

W. P. S.

**Condensation of Monosaccharides by Means of Dilute Mineral Acid.** **P. A. Levene and R. Ulpts** (*J. Biol. Chem.*, 1925, **64**, 475-483.)—Conditions are described under which the 2, 5-anhydro hexoses may easily be condensed through the action of dilute mineral acids. It is not certain whether the condensation product of chitose was a di- or polysaccharide. Chondrose has not as yet been prepared, but its condensation has been effected. The behaviour of simple monosaccharides—glucose, mannose and xylose—has been tested when treated under the conditions which brought about the condensation of the 2, 5-anhydro sugars. Condensed glucose was more soluble in water, but showed greater resistance towards hydrolytic agents than condensed chitose. Apparently it is a disaccharide. The product was completely hydrolysed by 2 per cent. sulphuric acid in a sealed tube at the temperature of the boiling water bath only after 420 minutes, whereas the water-insoluble product of chitose was practically completely hydrolysed in



90 minutes. Mannose and xylose behaved in exactly the same manner as glucose. Little can be said as to the structure of the condensation products, but in the main they appear to be built upon the plan of trehalose. The products were not hydrolysed by invertase, diastase and maltase, but they were to some extent by emulsin. The specific rotations of the condensation products of the simple sugars were higher than those of the equilibrium forms of the sugars, whereas those of the 2, 5-anhydro sugars had practically the same specific rotations as the original sugars. The condensation products of the 2, 5-anhydro sugars seem less stable than those of the simple sugars.

P. H. P.

**Relation of Pectose and Pectin in Apple Tissue.** M. H. Carré. (*Biochem. J.*, 1925, **19**, 257-265.)—The author shows that the views of Tutin (*Biochem. J.*, 1923, **17**, 510) on the non-existence of protopectin (pectose) cannot be maintained by the evidence afforded by his experiments. On the contrary, chemical investigations, borne out by microscopical work, indicate the presence of an insoluble pectic constituent of the cell-walls of apple tissue, which is referred to as pectose, and which is converted into the soluble modification, known as pectin, by the action of water and by dilute acids and alkalis, the nature of the change probably being hydrolytic. Although mechanical disintegration is important in facilitating the process of hydrolysis, it is not, as Tutin claims, the essential factor in the removal of the pectic constituents of apple tissues, since the necessity for disintegration is obviated if a sufficiently powerful reagent is used for extraction purposes.

P. H. P.

**Detection of Acetone in Spirits.** I. M. Kolthoff. (*Pharm. Weekblad*, 1925, **62**, 652-655.)—By the oxidising action of chloramine (the sodium salt of *p*-toluene-sulpho-chloramide) in the presence of potassium iodide, alkali, and dilute ethyl alcohol, a red non-crystalline deposit of iodoform is obtained, slowly at the ordinary temperature and more rapidly at 60° C. The red precipitate does not change into the yellow crystalline modification on standing, but if dissolved in strong alcohol the ordinary yellow crystals are formed on evaporation. The precipitate is obtained in about a minute with a concentration of 0.5 per cent.; after 10 minutes with 0.1 per cent.; and after an hour with 0.025 per cent. of ethyl alcohol. With acetone under the same conditions a heavy precipitate of yellow crystalline iodoform is obtained at concentrations of 1 in 1000 to 4 in 100,000; after 1 minute with 1 in 100,000; and after 10 minutes with 2 in 1,000,000. It is not possible to regulate the reaction in the presence of sodium hydroxide, so that the ethyl alcohol shall not react, while the acetone does, but by substituting ammonia for sodium hydroxide as little as 1 part of acetone in 10,000 parts of strong spirits may be detected. Ten c.c. of a solution containing about 10 per cent. of ethyl alcohol are mixed with 100 mgrms. of potassium iodide, 100 mgrms. of chloramine, and 10 to 20 drops of ammonia solution. A crystalline deposit of iodoform will be formed within 10 minutes in the presence of 0.1 per cent. of acetone; within 30 minutes with 1 part in 2500 to 5000; and after 2 hours with 1 part in 10,000.

**Characteristic Reaction for Luminal (Gardenal).** F. Ranwez. (*J. Pharm. Chim.*, 1925, **117**, 69-70.)—On mixing 0.1 gm. of luminal (phenyl-ethyl-barbituric acid), 0.5 gm. of potassium nitrate and 2 c.c. of concentrated sulphuric acid in a test tube and heating on a boiling water bath for 10 minutes, the mixture becomes yellow, and on pouring it into 10 c.c. of cold water the yellow solution becomes cloudy on cooling, and deposits a crystalline precipitate, which dissolves in ammonium hydroxide to form an intensely yellow solution. The nitro-luminal precipitate may be reduced by addition of zinc, when solution occurs with liberation of hydrogen. The clear liquid (amino-luminal) is decanted, acidified and cooled to 0° C., and about 0.1 gm. of potassium nitrite dissolved in water added. The diazoluminal formed remains in solution and gives a large range of colour reactions with different phenolic derivatives. The reaction with  $\beta$ -naphthol is very characteristic; it is obtained by adding a little powdered reagent and rendering the liquid alkaline, when an intense blood-red colour is formed. D. G. H.

**Detection and Determination of *p*-Sulphamino-benzoic Acid in Saccharin and Crystallose.** I. M. Kolthoff. (*Pharm. Weekblad*, 1925, **62**, 548-553.)—For the detection of *p*-sulphamino-benzoic acid (*p*-saccharin) 0.25 gm. of the saccharin and 0.2 gm. of sodium acetate are dissolved in 3 c.c. of hot water, and the clear solution cooled and treated with 5 drops of nitric acid. If, after standing for a day, there is any separation of crystals, the sample contains more than 2 per cent. of *p*-saccharin. Crystallose can be tested in the same way, but the addition of the sodium acetate is unnecessary in that case. After neutralisation of the carboxyl group of *p*-saccharin (methoxy red as indicator), the sulphamine group still shows weak acid properties. Further titration with alkali, with nitramine as indicator, will then afford an approximate determination of the amount of the pure compound in saccharin.

**Determination of Thyroxin in Thyroid Glands and Preparations.** T. A. Redonnet. (*Compt. Rend. Soc. Biol.*, 1924, **91**, 816-817; *Chem. Abstr.*, 1925, **19**, 838.)—From 2 to 3 grms. of the dry gland, 8 to 10 grms. of fresh gland, or 10 c.c. of a glycerin extract are mixed with 10 c.c. of 10 per cent. sodium hydroxide solution and 10 c.c. of 5 per cent. potassium nitrate solution in a 200 c.c. Nickel crucible, and the mixture evaporated over a small flame and then fused. The ash is powdered, mixed with 60 to 100 c.c. of hot water, and the liquid filtered into a special apparatus. This consists of a graduated tube fused to a glass bulb of 200 c.c. capacity. The tube is 2 cm. in diameter, and 15 cm. long, and is drawn out to a neck in which is fitted a stopper; the lower end is marked to indicate 10 c.c. From 30 to 40 c.c. of 10 per cent. sulphuric acid are added to the filtrate, the apparatus shaken to remove carbon dioxide, and chloroform poured into the 10 c.c. graduated portion. On now adding 5 c.c. of 10 per cent. sodium nitrite solution the idoine is liberated and taken up by the chloroform. A series of similar tubes, 15 in number, is so arranged that each contains in 10 c.c. a definite amount of iodine which corresponds to 0.25, 0.5, 1.0, 1.5, 2.0, 2.5 mgrms. of thyroxin. The quantity of thyroxin in the original material may be very closely determined by this colour comparison.

## Biochemical, Bacteriological, etc.

**Effect of Heat on the Solubility of the Calcium and Phosphorus Compounds in Milk.** R. W. Bell. (*J. Biol. Chem.*, 1925, **64**, 391-400.)—Considerable difference of opinion still exists as to the probable effect of heat on the chemical and physical properties of the mineral salts of milk. Experiments are described which were carried out on fresh skim milk. Milk was heated to various temperatures in order to study the effect of heat on the solubility of the calcium and phosphorus content. These studies were made with the aid of Pasteur-Chamberland filters and a high speed supercentrifuge. It appears from the results that there is a loss in the soluble calcium and phosphorus contents of the skim milk due to heat, and that the amount of the loss depends upon the temperature to which the milk has been heated. The results from the methods employed indicate that definitely measurable amounts of these substances are removed from solution in milks heated to 170° F. or higher. P. H. P.

**Influence of Different Substances on the Diastatic Activity of Saliva.** H. Walker. (*Biochem. J.*, 1925, **19**, 221-225.)—Experiments were carried out to determine the action of sweet substances on the diastatic activity of saliva. Two effects were considered:—(1) An increase or decrease in the quantity, or possibly the quality, of the ptyalin secreted; (2) a stimulating or depressing action on the enzyme produced by the substance being tested. Instead of taking the achromic point as a measure of diastatic activity, a series of standard colours was made, ranging from blue through purple, red-purple, red-brown to yellow, and, by comparison of the experimental colours with those of a standard, a graph was plotted for the diastatic activity. The graphs plotted are reproduced. Of the substances examined, cane sugar and saccharin in the mouth appear to have the most marked effect in producing a very active saliva. In the case of cane sugar this is largely, if not entirely, due to its stimulating action on the ptyalin. Maltose increases the quantity of ptyalin produced, but its presence depresses the activity of the enzyme. Lactose, on the other hand, tends to inhibit the production of ptyalin, but enhances its activity. Of the monosaccharides, glucose and fructose both lower the activity of saliva, largely owing to the depressing action of the sugar on ptyalin. Galactose has very little effect, and glycerol in the mouth has a retarding influence. P. H. P.

**Effect of Halogen Salts on Salivary Digestion.** W. M. Clifford. (*Biochem. J.*, 1925, **19**, 218-220.)—In an experiment on the rate of salivary digestion of starch no alteration of the time required to reach the achromic point was found with normal sodium fluoride, but a very delayed action was found with normal potassium fluoride. Experiments, which are described, were carried out to see if the salts of the other halogens show similar differences. Normal solutions of sodium chloride, potassium chloride, ammonium chloride, calcium chloride, and of the corresponding bromides, iodides and fluorides were used. Calcium fluoride

is practically insoluble, so that results with it are unreliable. The hydrogen ion concentration of each salt was determined and considered. A table shows that the chlorine ion exerts a definite accelerating action on the rate of salivary digestion, that the bromine ion is inert, and that the metallic ion is relatively unimportant in this connection. With the fluorides and iodides there are marked differences, some of the salts delaying digestion, whilst others are inert. This difference does not seem to be due either to the metallic ion, or to the hydrogen ion concentration of the salt solution, but to be a definite effect of the salt as a whole, independent of the hydrogen ion concentration or the position of the ions in the periodic system.

P. H. P.

**Saponins. III. The Sapogenin Occurring in *Sapindus saponaria* L. and *Sapindus mukorossi utilis* (Trabuti).** W. A. Jacobs. (*J. Biol. Chem.*, 1925, 64, 379-381.)—The sapogenin obtained from the saponin in the shells of commercial soapnuts has been identified by Jacobs (*J. Biol. Chem.*, 1925, 63, 621, 631) as hederagenin, the sapogenin which has been found in ivy leaves, *Hedera helix*. It was important to establish definitely the botanical identity of the nuts. The shells of the fruit of *Sapindus saponaria* L. from Florida were obtained, and when worked up yielded hederagenin. Since the nuts of this plant differed in general appearance from the commercial nuts used in the original investigations, nuts were obtained from Algiers of the variety *Sapindus mukorossi utilis* (Trabuti). The shells of these nuts, which closely resembled the commercial variety with which the author had worked, also yielded hederagenin. In each case the methyl ester and its acetyl derivative were prepared for further confirmation. Other workers have reported a different formula for the sapogenin from *Sapindus mukorossi*. The sapogenin which is obtained from *Hedera helix*, as well as from *Sapindus saponaria* L. and from *Sapindus mukorossi utilis*, is hederagenin, which has the formula  $C_{31}H_{50}O_4$  and melts at 332-334°. The experimental work is described.

P. H. P.

**Influence of Blood Serum and of Sugars on Hæmolysis.** W. P. Kennedy. (*Biochem. J.*, 1925, 19, 318-321.)—Ponder (*Proc. Roy. Soc. Lond.*, 1923, B, 95, 42), who has investigated only the action of serum and of simple proteins on hæmolysis, has shown that the protein content of the serum is the chief factor in the production of inhibition. The author has confirmed Ponder's results on the inhibition of saponin hæmolysis by serum. The method used is the simple one devised by Ponder (*Proc. Roy. Soc. Lond.*, B, 92, 285; B, 93, 86). Figures and tables show the results. It is also shown that glucose and fructose inhibit saponin hæmolysis in a manner much like that of serum. Galactose accelerates the action of saponin, and starch has no effect thereon. It is strange that two such closely allied sugars as glucose and galactose should have such diametrically opposed effects on the action of saponin.

P. H. P.

**Semi-selective Antiseptic Effect of Vapours of Vegetable Oils, Essential Oils, their Constituents, and Similar Compounds.** O. Schöbl. (*Philippine J. Sci.*, 1925, 26, 501-504.)—The susceptibility of *B. tuberculosis*, *B. typhosus*,

*B. coli*, *B. dysenteriac*, *Vibrio cholerae*, *B. anthracis*, *B. pyocyaneus*, and gram-positive and gram-negative pathogenic bacteria has been investigated. *B. coli* exhibits greater resistance than *B. dysenteriae*, and the latter greater than *B. typhosus*, but there is no selective action of the compounds used as far as this group of bacteria is concerned; allyl alcohol, however, inhibits *B. coli* more than it does *B. dysenteriae*. The organisms of the same group are unaffected by cynol or citrus microsporin oil, which inhibit *Vibrio cholerae*. In the cocci group also there are only slight quantitative differences between the behaviours of the individual members. The most pronounced selective action was shown by *B. tuberculosis*, and to a less extent by *B. anthracis* (anisol, anethol, pittosporum oil, and turpentine). The results of the tests are shown in diagrammatic form.

T. H. P.

### Unusual Crystalline Forms of Calcium Oxalate in Urine Deposits.

**B. Bardach.** (*Chem. Zeit.*, 1925, 49, 662.)—In addition to the usual quadrilateral (envelope) crystals of calcium oxalate, other crystalline forms may occur in urine deposits under certain conditions. These include egg-shaped and elongated crystals, globular, and disc or ring-shaped forms, and appear to be due to the effect of the inclusion of other calcium salts (calcium carbonate, etc.), as well as to changes in the reaction of the urine. The disc form of crystals may readily be mistaken for erythrocytes, and in doubtful cases the solvent action of dilute hydrochloric acid should be noted under the microscope.

## Toxicological and Forensic.

**Poisoning by Shoe Dyes.** C. W. Muehlberger. (*J. Amer. Med. Assoc.*, June 27, 1925, p. 1987; *Lancet*, 1925, 209, 262.)—Details are given of 56 cases of poisoning caused by aniline or nitrobenzene, including 9 recent cases in U.S.A. Poisoning due to the splashing of these compounds on the skin is recorded, painters using paints containing aniline have been affected, and certain hair preparations containing aniline have produced dangerous symptoms. Even the aniline marking ink applied to diapers has been known to produce effects in infants. Aniline and nitrobenzene, even when pure, can be absorbed through the unbroken skin. The symptoms produced by wearing shoes stained with dye preparations containing these compounds are intense cyanosis, followed by collapse, with weakness, dizziness, headache and vomiting. Recovery usually takes place rapidly after the shoes have been removed, but there is at least one fatal case on record. In no instance has methaemoglobin been found in the blood, although the cyanosis occurring in these cases is frequently ascribed to this cause. Chemical analysis of one brand of shoe dye showed that it contained over 40 per cent. of aniline, and it is suggested that the use of both aniline and nitrobenzene in the manufacture of shoe dyes should be prohibited. The ill effects could be prevented by not wearing the shoes until some time after staining, and by discontinuing the practice of staining shoes "while you wait" on a person's feet, which appears to be common in America.

## Water Analysis.

**Determination of Minute Amounts of Phenols in Polluted Natural Waters.** L. R. Vorce. (*Ind. Eng. Chem.*, 1925, 17, 751.)—Two litres of the water are treated with 2 grms. of sodium hydroxide, filtered, and 25 c.c. of hydrogen peroxide are added to the filtrate; after eighteen hours, the solution is evaporated to a volume of 200 c.c. in a nickel or porcelain basin, the residual solution is transferred to a flask, cooled, 45 grms. or more of citric acid are added, and the mixture is distilled; the receiver is a 500 c.c. flask, and the lower end of the condenser should reach to the bottom of the flask. When about 125 c.c. of distillate have been collected 100 c.c. of water are added to the distillation flask, and the distillation continued, and so on, until the receiver is nearly full. The contents of the receiver are then diluted to 500 c.c. Portions of this solution are then treated with Folin and Denis phenol reagent, and the coloration obtained compared with that given by a known quantity of standard phenol solution. The reagent is prepared by dissolving 100 grms. of sodium tungstate, 18 grms. of molybdenum trioxide, and 50 c.c. of 85 per cent. phosphoric acid in 750 c.c. of water; the mixture is boiled for two hours under a reflux condenser, then cooled and diluted to 1000 c.c. One c.c. of the reagent and 5 c.c. of saturated sodium carbonate solution are required for each 1 part per million of phenol in the test solution; at least one hour is required for the complete development of the colour. W. P. S.

## Organic Analysis.

**Elementary Organic Analysis by a Wet Method.** G. Vortmann. (*Zeitsch. anal. Chem.*, 1925, 66, 272–275.)—The following modification of Strebinger's method for the determination of oxygen in organic substances (*Z. anal. Chem.*, 1919, 58, 97) will allow of the determination of carbon and oxygen, and calculation of the hydrogen content. The substance is oxidised with sulphuric acid and potassium iodate in known excess, the carbon dioxide being collected in a soda-lime tube. The liberated iodine will have to be absorbed in potassium iodide solution, after which the gas is dried over sulphuric acid. The oxygen used up in the oxidation is ascertained by determination of the unchanged iodate; and as the oxygen contained in the carbon dioxide is known, the excess oxygen can be calculated to its equivalent of hydrogen. W. R. S.

**Determination of Arsenic in Organic Compounds.** G. Newberry. (*J. Chem. Soc.*, 1925, 127, 1751–1752.)—Decomposition is effected by heating together 0.2 gm. of the substance, 4 to 5 grms. of ammonium persulphate and 20 c.c. of water in an Erlenmeyer flask provided with an anti-spray device, until, after about 15 minutes, the mixture is quite colourless. After additions of 40 c.c. of *N* oxalic acid heating is continued until noticeable evolution of carbon dioxide ceases, when 20 c.c. of 2 *N* sulphuric acid and 10 c.c. of 10 per cent.

potassium iodide solution are added, together with a piece of porous porcelain. The mixture is boiled for about 15 minutes until the liberated iodine is almost completely expelled. The remaining colour is then discharged by the cautious addition of 0.5 *N* sodium thiosulphate solution, and the mixture immediately diluted to about 100 c.c., 30 c.c. of 2 *N* sodium carbonate solution added, and subsequently about 1 grm. in excess of the amount of solid sodium bicarbonate required to obtain neutrality to litmus. After warming to 35–40° C. the mixture is titrated with 0.1 *N* iodine solution.

D. G. H.

**Determination of Oleic Acid as Dihydroxystearic Acid.** **A. Lapworth and E. N. Mottram.** (*J. Chem. Soc.*, 1925, **127**, 1628–1631.)—Even comparatively impure samples of oleic acid may be analysed as follows, particularly with regard to the determination of all saturated fatty acids not volatile in steam. A clear solution of the sodium salts from about 5 grms. of the "oleic acid" is cooled, diluted with 4 litres of ice-cold water, and 400 c.c. of 1 per cent. potassium permanganate solution slowly added at 10° C., with continual shaking. After 5 minutes sulphur dioxide is used to decolorise the liquid, and 150 c.c. of concentrated hydrochloric acid are added. The crude solid dihydroxystearic acid thus precipitated is drained, washed with about 50 c.c. of petroleum spirit (the washings being kept), and dried to constant weight, then extracted with 100–500 c.c. of petroleum spirit (b. pt. 70–80° C.), the whole cooled, and filtered, the residue of nearly pure dihydroxystearic acid washed, and the washings and extract combined and evaporated. The residue from these is distilled in steam to remove any volatile fatty acids, and the non-volatile acids are then extracted with petroleum spirit. The solvent is evaporated, and the acids heated on a water bath to constant weight.

D. G. H.

**Interfering Effect of Glycerol on the Biuret Reaction.** **F. B. Seibert and E. R. Long.** (*J. Biol. Chem.*, 1925, **64**, 229–231.)—Glycerol interferes markedly with the delicacy of the biuret test, presumably through its combining power for copper hydroxide. If the copper is bound by the glycerol in such form that it is not available for combination with protein, the biuret colour cannot appear. As small an amount as 0.33 per cent. prevents the reaction in solutions of casein and gliadin of 1:9,600 concentration, and in solutions of tuberculin protein (produced by the growth of the tubercle bacillus in a non-protein medium) of 1:4,800 concentration, the limiting concentrations at which these proteins give a positive biuret test in the absence of glycerol. At a concentration of 16.66 per cent. glycerol reduces the apparent protein concentration fourfold; *i.e.* the colour developed is weak, corresponding to that found in a dilution of protein four times as great in a solution containing no glycerol. This inhibitory action of glycerol on the biuret test is of great significance in testing non-protein bacteriological culture media for the development of protein as a result of bacterial growth. Ammonium citrate in concentrations corresponding to those used in culture media does not inhibit the development of the biuret colour.

P. H. P.

**Determination of Phenols in Tar Oils.** J. J. Morgan and M. H. Meighan. (*Ind. Eng. Chem.*, 1925, 17, 626, 628.)—In the process described a weighed portion of the sample, dried previously over calcium chloride, is placed in a wide test-tube containing granular sodium and a small quantity of toluene; the mixture is heated, and the liberated hydrogen is conducted through a side tube to a measuring burette, where it is collected over mercury and its volume measured. The liberation method for the determination of tar acids may be modified, in order to eliminate variations due to oils included in the phenolate solution, by acidifying the latter with sulphuric acid, extracting the acid solution with benzene, diluting the benzene solution to exactly 100 c.c., and shaking this out with successive quantities of sodium hydroxide solution. The decrease in the volume of the benzene solution is a measure of the volume of the tar acids present. W. P. S.

**Iodimetric Determination of Methylene Blue.** T. Sabalitschka and W. Erdmann. (*Chem. Zeit.*, 1925, 49, 561.)—When treated with a solution of iodine in potassium iodide, methylene blue (1 mol.) takes up iodine (4 at.) with formation of a brownish-black precipitate, the excess of iodine in the liquid being determinable by titration with thiosulphate. The procedure is as follows:—A quantity of 0.15 gm. of the commercial methylene blue is dissolved in water, the solution diluted to 100 c.c., 50 c.c. of this solution treated, drop by drop, and with shaking, with 10 c.c. of 0.1 *N* iodine solution, and the liquid then diluted with water so as to give a clear liquid layer above the precipitate. The solution is titrated with 0.1 *N* sodium thiosulphate solution until the supernatant liquid appears distinctly blue by transmitted light. If  $x$  c.c. of thiosulphate are required, the percentage of methylene blue hydrochloride is given by  $12.46(10 - x)$  or that of anhydrous methylene blue chloride by  $10.66(10 - x)$ . T. H. P.

**The Seed Hairs of the Milkweed.** A. W. Schorger. (*Ind. Eng. Chem.*, 1925, 17, 642.)—The seed hairs of the milkweed (*Asclepias syriaca*), like those of cotton, are unicellular and almost colourless; on account of their lustre they are classified with the vegetable silks, but brittleness and slight felting properties make them of minor importance in the textile industry. A sample had the following composition: Lignin, 22.18; pentosans, 34.55; methylpentosans, 1.05; methoxyl 3.60; cellulose, 60.40;  $\alpha$ -cellulose in cellulose, 58.64; matter soluble in alcohol, 4.28; matter soluble in ether, 1.35; ash, 0.97 per cent. W. P. S.

**Determination of the Copper Numbers of Cellulose Materials.** C. J. Staud and H. L. B. Gray. (*Ind. Eng. Chem.*, 1925, 17, 741–742.)—The following procedure is recommended in order to obtain concordant results in the determination of the copper numbers of materials such as paper, cotton, cellulose, etc.:—Three grms. of the sample are placed in a 1.5 litre flask fitted to a reflux condenser and provided with a stirrer, and the flask is placed in a bath at 100° C. In another flask are placed 350 c.c. of water, 20 c.c. of copper sulphate solution (137 grms. of copper sulphate in 2000 c.c. of water) and 30 c.c. of alkaline tartrate solution, (692 grms. of potassium sodium tartrate and 200 grms. of sodium hydroxide in



2000 c.c. of water), the mixture is heated to 100° C., and added to the contents of the first flask which is then kept at 100° C. for forty-five minutes while its contents are stirred gently. The solution is filtered immediately through two sheets of Whatman No. 5 filter paper or through prepared asbestos, and the material on the filter is washed first with 1 litre of cold water and then with 750 c.c. of boiling water. The filter funnel is placed over another flask, 25 c.c. of ferric alum solution (100 grms. of ferric ammonium alum dissolved in 700 c.c. of water, acidified with 140 c.c. of concentrated sulphuric acid and diluted to 1000 c.c.) are poured on the filter and allowed to drain into the flask, and the filter is washed with two 50 c.c. portions of 2 *N* sulphuric acid ; the solution in the flask is then titrated with 0.04 *N* permanganate solution. The copper number = c.c. of 0.04 *N* permanganate used  $\times 0.00254 \times 100$ /weight of sample.

W. P. S.

## Inorganic Analysis.

**Determination of the Oxygen Content of Commercial Oxygen.** B. Neumann and W. Steuer. (*Chem. Zeit.*, 1925, 49, 585.)—In the determination of the percentage of oxygen in compressed oxygen the methods based on combustion in a tube filled with copper gauze and collection of the nitrogen, and on absorption with either copper in ammonium carbonate and ammonia, or sodium hydro-sulphide, or phosphorus yield concordant results. When, however, gas of such high oxygen content is absorbed by alkaline pyrogallol solution, carbon monoxide is formed in amount depending on various factors ; if the carbon monoxide is absorbed and the volume of the residual gas measured, trustworthy results are obtainable.

T. H. P.

**Determination of Carbon Dioxide and of Carbon Monoxide.** P. Lebeau and P. Marmasse. (*Compt. rend.*, 1925, 180, 1847–1850.)—Since carbon dioxide has no measurable vapour pressure at the temperature of liquid air, it may be separated from a gaseous mixture by means of this cooling agent and afterwards determined. Carbon monoxide may be determined similarly if first converted into the dioxide by means of iodic anhydride at 150° C. In the case of a complex mixture of gases, use may be made of a bell-jar about 45 mm. in diameter and 15 cm. high, standing in a mercury bath and surmounted by a glass tube 15 to 20 mm. wide and 80 cm. long, with a small ground-glass valve at the top. Above the valve is fused a tube, 6 mm. wide, connecting the jar with two condensers cooled by liquid air, followed by an arrangement permitting of the action of iodic anhydride at 150° C., and of the retention of the iodine thus formed as mercuric iodide ; this is connected, *via* one or two condensers at 190° C., with a mercury pump. To determine carbon monoxide, a definite volume of the gaseous mixture is introduced into the bell jar and then slowly extracted by means of the pump, the condensers being immersed in liquid air and the iodic anhydride heated to 150° C. The homologues of methane, the ethylenic and acetylenic hydrocarbons, and the carbon dioxide are retained in the first condensers, and of the other gases, the carbon monoxide is converted by the iodic anhydride into the dioxide, which is

solidified in the subsequent condenser. Communication with the first condensers is interrupted by mercury valves, and the carbon dioxide in the last condenser expelled by heat and its volume measured; it is then absorbed by baryta solution and again measured. The original carbon dioxide of the gaseous mixture is then determined similarly. This procedure yields highly accurate results.

T. H. P.

**Explosion Method for Peroxide Fusions.** W. F. Muehlberg. (*Ind. Eng. Chem.*, 1925, 17, 690–691.)—The following method is applicable to such substances as ferrosilicon, chrome ore, fluorspar, etc.:—0.5 gm. of the finely powdered sample and 0.7 gm. of sugar carbon are placed in a nickel crucible of about 60 c.c. capacity, and 15 grms. of sodium peroxide are added. After mixing, the contents of the crucible are tamped with a flat glass stopper, and the crucible is covered and placed in a hole in the cover of a cooling pan filled with water almost up to the under side of the cover. A piece of string is gripped in a pair of crucible tongs, the end of the string is lighted and inserted through a small hole in the cover of the crucible; the mixture ignites promptly and easily. When cold, the contents of the crucible are shaken into a beaker, water is added, and, when the action has moderated, the crucible is rinsed with water. The solution is diluted to 300 c.c. and acidified with hydrochloric acid; the hydrated silicic acid remains completely in solution. If any undecomposed particles of the sample are observed, they must be separated by filtration, washed, ignited and weighed; when the quantity does not exceed 15 mgrms. the weight may be deducted from the original weight, but if the undecomposed portion is large, it should be fused with about 1 gm. of sodium carbonate, the fused mass dissolved in water, and the solution added to the main filtrate. This is then evaporated to dryness, and the silica separated from the other constituents in the usual way.

W. P. S.

**Determination of Lead.** W. W. Scott. (*Ind. Eng. Chem.*, 1925, 17, 678.)—A modification of the dichromate method is described in which the chromate is titrated with ferrous sulphate solution, diphenylamine being used as indicator. The lead is separated as sulphate and converted into lead chromate in the usual way; the lead chromate is then dissolved in 50 c.c. of sodium chloride solution containing hydrochloric acid (saturated sodium chloride solution, 1000 c.c., water, 120 c.c., and hydrochloric acid of sp. gr. 1.20, 100 c.c.), the solution is diluted to about 150 c.c., and treated with 10 c.c. of a mixture of phosphoric acid and sulphuric acid (1:1) and 6 drops of a 1 per cent. diphenylamine solution (in sulphuric acid). An excess of 0.1 *N* ferrous sulphate solution is added, and the excess is titrated with 0.1 *N* dichromate solution until the green colour changes to blue. If much hydrochloric acid is present, the final coloration is dark green, but this changes to blue on the addition of ammonium acetate.

W. P. S.

**Analysis of White Metal.** H. Biltz. (*Zeitsch. anal. Chem.*, 1925, 66, 257–272.)—The following methods, after several years' testing, are recommended as thoroughly reliable. 1. *Gravimetric.* The alloy, in form of thin strips or

cuttings (1 gm. if rich in lead, 1.5 gm. of rich in tin) is treated in a porcelain dish with 12 to 15 c.c. of strong nitric acid added gradually. When the action is over, the acid is evaporated just to dryness. The evaporation with nitric acid is repeated once or twice more if the alloy is rich in lead. The dry mass is rubbed to a fine powder with a glass rod, and well mixed with 8 parts of pure crystallised sodium sulphide. The mixture is gently heated so that the salt melts in its water of crystallisation, the dish being covered to prevent evaporation. The digestion is continued, with occasional stirring, for 20 to 30 minutes. The still warm mass is mixed with 10 to 15 c.c. of fresh ammonium sulphide and 1 to 2 grms. of sodium sulphide, and evaporated until it no longer smells of ammonia. Boiling water (100 c.c.) and a few grms. of ammonium nitrate are added, and the solution kept near the boiling point for  $\frac{1}{2}$  to 1 hour. This treatment renders the whole of the tin soluble and re-precipitates any dissolved copper and iron. The precipitate is collected and washed with dilute sodium sulphide solution and, finally, with hydrogen sulphide water containing ammonium nitrate; it is examined in the usual manner for lead, copper, iron, and zinc. Tin and antimony are separated in the filtrate (or an aliquot part thereof) according to Henz's modification of Clarke's method (*Zeitsch. anal. Chem.*, 1907, **46**, 593). Tin is recovered as sulphide, which is purified by solution in ammonium sulphide and re-precipitation, and ignited to oxide. The above process is applicable to the determination of impurities in commercial tin; 10 grms. are oxidised with 20 c.c. of nitric acid, and the dry residue treated with 60 to 70 grms. of crystallised sodium sulphide.

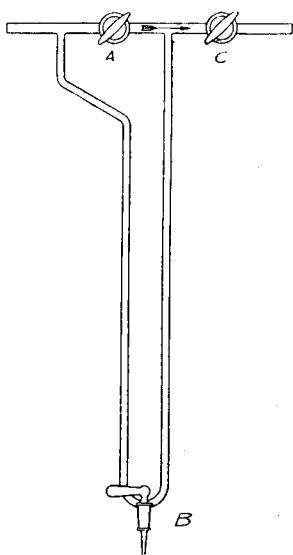
2. *Volumetric.* The alloy is dissolved by boiling with 20 c.c. of strong sulphuric acid. When sulphur dioxide has been expelled, the mass is cooled and diluted with 50 c.c. of water, 5 of strong hydrochloric acid, and again 50 of water. The solution is titrated at the ordinary temperature with 0.1 N bromate solution and a drop of methyl orange (1:1000) to the disappearance of the pink colour, giving antimony. The lead sulphate precipitate is next filtered off after two hours' standing: this result is 0.2 per cent. low. The filtrate (or an aliquot part) is treated in the cold with 20 c.c. of strong hydrochloric acid (in a 1000 c.c. flask fitted with a Contat-Göckel valve) and 8 grms. of pure zinc cuttings. For exact results complete precipitation of tin by the zinc is considered essential. When the zinc is dissolved another 4 grms. are added and, after 20 minutes, 70 to 80 c.c. of strong hydrochloric acid. The remaining zinc and the tin sponge are dissolved by gentle warming: antimony and copper are insoluble. The flask is cooled in running water, and its neck washed down with 100 c.c. of water containing 0.2 gm. of potassium iodide, 5 c.c. of starch solution, and 10 c.c. of dilute hydrochloric acid, and freed from oxygen by addition of a little bicarbonate. The solution is immediately titrated with 0.1 N bromate to the appearance of a blue colour. The titration is carried out in duplicate: the second and final assay in the bulk of the bromate solution is added very quickly.

W. R. S.

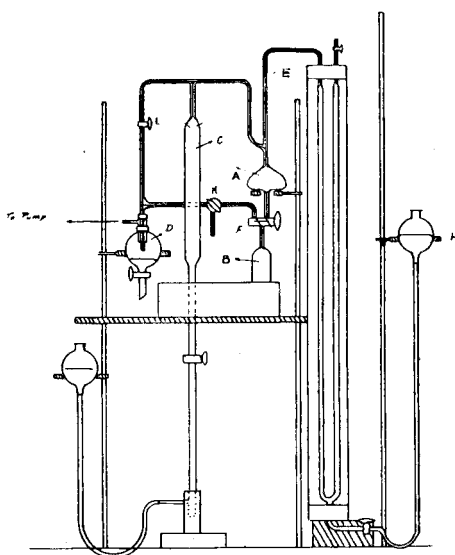
## Physical Methods, Apparatus, etc.

**Stopcock Orifice Flowmeter.** J. Sharp. (*Ind. Eng. Chem.*, 1925, 17, 646.)—The meter is constructed of glass and is suitable for use with gases such as ozonised air, etc., which attack rubber and metals. The variable orifice, *A*, is a tap of large bore, notched to close gradually so as to give a full-scale reading or differential head of about 41 cm. for any flow from 2.8 to 28 litres per minute. A light petroleum oil, sp. gr. 0.084, is used as the indicating liquid, and the tap *B*, allows the oil to be replaced without dismantling the apparatus. The tap, *C*, also of large bore and notched, regulates the flow. The apparatus is calibrated for a given orifice set against a gas meter, using air; by means of the tap *C*, adjustment may be made for the same back pressure that is used in the test. The pressure head varies directly as the square of the flow.

W. P. S.



Stopcock Orifice  
Flowmeter.



Apparatus for the Accurate Analysis  
of Small Quantities of Gas.

**Apparatus for the Accurate Analysis of Small Quantities of Gas.** D. S. Chamberlin and D. M. Newitt. (*Ind. Eng. Chem.*, 1925, 17, 621.)—The apparatus is intended for the analysis of a volume of gas measuring from 1 to 5 c.c., and operates on the constant-volume principle. The zero reading is obtained by lowering the reservoir *H*, and this is then raised until the U-tube is full of mercury. The sample is transferred to *B* and allowed to rise to the absorption vessel *A* by lowering *H*, which is then further lowered until the mercury is at the mark *E*; the tap *F* is now closed and *H* lowered to obtain the reading of the gas pressure. The reagent is drawn over into *B* through the taps *K* and *F*, any air is removed, and *F* is opened, so that the reagent is transferred slowly to *A*. When absorption

is complete the tap  $F$  is turned so that the reagent may be nearly all withdrawn,  $F$  is then closed and  $B$  is half filled with 1 per cent. sulphuric acid, which is drawn into  $A$  and afterwards discharged through  $F$ . The reservoir  $H$  is then lowered while  $F$  is open until the mercury level is at  $E$ ,  $F$  is closed, and the reading taken. To clear the gas from the apparatus the gas is transferred to  $A$  and then drawn by suction into  $D$ , while  $L$  and  $F$  are open. The U-tube is calibrated in millimetres.

W. P. S.

**Lithium Arc Spectrum for Polarimetric Use.** P. C. Austin. (*J. Chem. Soc.*, 1925, 127, 1752–1753.)—The introduction of lithium carbonate into the arc produced between carbon, copper or silver electrodes, and the use of a direct-vision spectroscopic eyepiece of high dispersive power enables extinction readings to be taken for the red line at  $\alpha=6708\text{\AA}$ , together with the sodium line at  $\alpha=5893\text{\AA}$ , and also for the orange line at  $\alpha=6104\text{\AA}$ , and, what is particularly useful, for the blue line at  $\alpha=4602\text{\AA}$ . The most satisfactory conditions involve the use of copper electrodes at right angles to each other, with a small quantity of paste of lithium carbonate and water fixed by a thin copper wire to the vertical positive electrode.

D. G. H.

**Rotary Dialyser.** A. Astruc and E. Canals. (*J. Pharm. Chim.*, 1925, 117, 14–17.)—The dialyser is mounted by means of elastic attachments on a hollow rotating axis in which is placed a rotating rod carrying at its lower end a four-armed glass stirrer of smaller diameter than the dialyser. The dialyser and stirrer rotate in opposite directions, and their speeds may be varied. They are immersed in distilled water which can be constantly renewed. By employing this arrangement dialysis is more rapid than in ordinary circumstances; the presence of gum arabic has no retarding effect on the process, and gum tragacanth has only a slight effect.

D. G. H.

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## Reviews.

ANNUAL TABLES OF CONSTANTS AND NUMERICAL DATA: CHEMICAL, PHYSICAL AND TECHNOLOGICAL. Volume 5, 1st part. Publisher for British Empire: The Cambridge University Press, Fetter Lane, London, E.C.4. Price (cloth bound), 300 Frs., or 225 Frs. to Members of Societies.

This volume of the Table of Constants deals with data for the years 1917–1922 inclusive. The Committee under whose auspices these “Tables” are prepared has had great difficulties of several sorts to encounter, but when Volume 6 appears, it is expected to contain “Constants” for the years 1923 and 1924, after which the publication of the “Tables” will resume its annual form.

The present volume, like its predecessors, contains a large mass of information in reference to such properties as co-efficients of expansion, density, viscosity,

surface tension, specific heats, thermal conductivities, melting points, boiling points, indices of refraction and other properties—chemical and physical—too numerous to mention. The publication in collected form of such data as are included in this important work is clearly a matter of very great convenience to teachers and research workers, and every scientific library of importance ought to possess a copy on its shelves.

A. CHASTON CHAPMAN.

REPORTS OF THE PROGRESS OF APPLIED CHEMISTRY. Vol. IX. 1924. Issued by the Society of Chemical Industry. Price to members, 7s. 6d.; to non-members, 12s. 6d.

The arrangement of the various sections follows that of previous years; the section on Photographic Materials and Processes, which was omitted in last year's Report, now reappears.

In the heavy chemical industry the depression in trade has continued, therefore it is encouraging to read that "the textile industry is much more buoyant and hopeful," after some years of depression. In the chapter on Soils and Fertilisers, by H. J. Page, a section on Insecticides is now included.

The considerable development of nitrogen fixation and of smokeless fuel manufacture which is taking place in this country is reflected in these reports. It will also be gathered that the outlook for the manufacture of beet sugar is very hopeful; about six or seven new factories should be at work by 1926. The Government subsidy, just passed into law, on home-grown sugar, will make the erection of these factories fairly certain.

In the section on foods, for which G. W. Monier-Williams is once more responsible, will be found admirable summaries of recent work on vitamins, milk powder and canned foods; the recently issued Report of the Departmental Committee on Preservatives in Food is also discussed here.

The writer of the chapter on Sanitation and Water Purification refers to the 1924 Report of the Metropolitan Water Board, and states, with reference to complaints of taste in water after the chlorination treatment, "It is to be hoped that in next year's report the matter will be more definitely dealt with," . . . etc.

In this connection it may be noted that, although the chlorination treatment is so widely used, its use is always enshrouded in secrecy. Surely the time has come when water authorities should take the public into their confidence. The "iodoform" taste, sometimes developed in chlorinated water, might cause complications to manufacturers of beverages, through complaints as to the taste of their goods.

As in previous years, these Reports give excellent summaries of the past year's work in the different fields of chemistry, and fuller information is easily available, as the bibliography to each section is very full.

R. LEITCH MORRIS.

THE FOUNDATIONS OF COLLOID CHEMISTRY. A SELECTION OF EARLY PAPERS BEARING ON THE SUBJECT. Edited, on behalf of the Colloids Committee of the British Association by EMIL HATSCHEK. Ernest Benn, Ltd. 172 pp. 18s.

The Colloids Committee of the British Association has done a useful piece of work in collecting and re-publishing this selection of pioneer papers in colloid chemistry. The selection contains Ascherson's paper on adsorption at an oil-water interface; Selmi's papers on the occurrence in colloidal form of certain salts normally regarded as typical crystalloids; papers by Faraday, Carey Lea and Muthmann, in which the existence of colloidal dispersions of pure metals is first recognised, and two classical papers, by Thomas Graham and van Bemmelen respectively, on the colloidal properties of silicic acid.

The collected papers all give striking testimony of the value of leisured thought in approaching a scientific problem. Lacking many of the refinements of modern analytical technique, these early workers had a full appreciation of the value to be obtained by weighing and comparing evidence from varied sources. At the present day, there is, perhaps, a tendency in the study of colloidal problems for the development of some highly specialised analytical technique, and for the limiting of theoretical deductions to the formulation of a mathematical expression to cover the quantitative results obtained by its use. In those older days when the balance was practically the only instrument of precision in chemical analysis, a greater use was made of the human eye as a scientific tool. Fortunately in the last few years, the eye, aided by the microscope and the ultra-microscope, is being restored to its rightful place in the technique of bio-chemistry. Its value as a tool is well illustrated in Ascherson's paper on "The Physiological Utility of the Fats." Ascherson watched the formation of membranes on oil drops immersed in solutions of egg-white, studied diffusion through these membranes, and compared the artificial droplets with the fat globules occurring in animal and vegetable cells. He noticed that "a drop of oil surrounded for an instant only by an albuminous liquid is immediately enclosed in a cell membrane," and he regarded the formation of these membranes "as a physical property, as a kind of capillary condensation which proceeds at the surface of heterogeneous liquids in contact"—a definition of adsorption that has hardly been bettered in the eighty-seven years that have since elapsed!

The value of ocular evidence in appraising a problem is again made very clear in the papers by Faraday and Carey Lea on gold and silver sols. The latter had evidently so much faith in it that he sent samples of his "blue-silver," "green-silver" and "gold-silver" to the editors of the *American Journal of Science*, together with the manuscript account of his researches. His samples evidently carried conviction, for the paper was published, and the author congratulated.

There is no doubt that studying a subject from every side, as these early workers did, as well as from some special angle, leads to a balanced judgment. By the exercise of a critical appreciation of all the facts before them, these pioneers

in colloidal chemistry achieved such a just comprehension of their subject, that the main stream of colloidal theory is still flowing through the channels which they marked out.

DOROTHY JORDAN LLOYD.

THE NATURE OF ENZYME ACTION. (Monographs on Biochemistry, edited by Dr. R. H. A. PLIMMER and Sir F. GOWLAND HOPKINS.) By the late Sir W. M. BAYLISS, M.A., D.Sc., F.R.S. Fifth Edition. Pp. viii. + 200. London: Longmans, Green & Co. 1925. Price 9s, net.

The present edition of this well-known monograph, although dated 1925, was revised by the author up to April, 1923, whilst, after his death, his son corrected the bibliography and index in 1924.

The text is divided into ten chapters under the following titles:—I. Catalysis in General, II. Enzymes as Catalysts, III. Physical and Chemical Properties of Enzymes, IV. General Methods of Preparation and of Investigation, V. Reversibility of Enzyme Action, VI. The Velocity of Reaction and the Various Conditions Affecting it, VII., VIII., Co-Enzymes and Anti-Enzymes, IX. Zymogens, X. Oxidation-Processes and Certain Complex Systems, General Conclusions, List of Literature Referred to, Index.

The subject-matter is admirably treated, mostly from the point of view of the animal physiologist, with a strong leaning towards physical science. Sir William Bayliss was a physiologist who throughout his career attempted to explain vital phenomena by purely physical laws, and, whilst no one will venture to deny that all the forces of nature are subject to, and governed by, the same laws, yet such a statement needs qualification in the case of vital processes. The old conception of the existence of a special *vis vitae* is no longer tenable, but it must be remembered that, whilst the kinetics of a given reaction may be studied *in vitro* without any disturbing influences, this is not so in the case of reactions *in vivo*. Here many reactions are proceeding simultaneously, and protoplasm is continually inducing fresh changes in different directions.

Defining an enzyme as a catalyst produced by living organisms, the author disclaims any desire to prejudge the possibility of the ultimate production of such a substance in the laboratory—a very remote one in the writer's opinion. He objects to speaking of enzymes as "selective" catalysts, as suggested by E. F. Armstrong, on the ground that such an enzyme as emulsin acts on a great variety of compounds, and yet on p. 92 he apparently accepts E. F. Armstrong's diagrammatic representation of the relation of the respective enzymes to the  $\alpha$ - and  $\beta$ -methylglucosides; and, again, on p. 141, he gives a representation of the same kind for maltase and emulsin. In all probability an enzyme is a system, as Bertrand has pointed out, rather than a discrete compound, otherwise it is difficult to realise division into enzyme and co-enzyme. It has been fairly well established that the presence of protein in an enzyme preparation is unnecessary. Mannose has been shown to be a constituent of invertase, even in the case of very active preparations. Yet Willstätter's invertase was said to be free from protein, carbohydrate and phosphorus. In any case, however, enzyme preparations are seldom functionally pure,



but the specificity of an enzyme is a fundamental axiom. Malt diastase preparations invariably contain soluble diastase of translocation as well as diastase of secretion, the former acting on  $\alpha$ -hexa-amylose and the latter on  $\alpha$ - $\beta$ -hexa-amylose (Ling and Nanji, 1923, 1925). In this connection Henry and Auld's observation (1905), cited on p. 63, that ordinary brewers' yeast probably contains emulsin is significant. The main hydrolytic enzyme is naturally maltase. In their recent studies on starch Ling and Nanji have shown that isomaltose is a  $\beta$ -sugar and is therefore hydrolysed by emulsin. Now it is well known in practical brewing that single cell yeast fails to bring about what is called the secondary fermentation of beers. This fact was firmly established by the late Horace T. Brown. In the primary fermentation it is the sugar, maltose, containing an  $\alpha$ -linkage between the glucose residues which ferments, the carbohydrates left being probably maltodextrins,  $\beta$ -glucosidomaltose and certainly isomaltose, which latter contains a  $\beta$ -linkage only. It would seem, therefore, that yeast after going through many generations in the brewery, acquires the power of breaking down  $\beta$ -linkages, so that the presence of emulsin in ordinary brewers' yeast is not surprising.

The author, dealing with the velocity of reactions brought about by enzymes, points out the divergence in some cases from the law of unimolecular reactions. In the case of Henri's experiments on the hydrolysis of sucrose by invertase, he does not mention under "causes of divergence from the simple law" (p. 84) that one of the causes of such divergence is mutarotation. Hudson's observation (1908), that when this is taken into account, the velocity constants for the hydrolysis of sucrose by invertase are those required by a unimolecular reaction is alluded to, however, on p. 98. A. E. Taylor (1909), it may be added, showed that the same applied to the velocity values for the hydrolysis of maltose by maltase. It is pointed out, however, that Sørensen (1909) considers that Hudson attaches too much importance to this factor, and that the time course depends on the concentration of hydrogen ions in solution. On this point the author remarks that what Ostwald has termed "autocatalysis" (change of  $H^+$ - and  $OH^-$ - ion concentration during the reaction) is the main factor accounting for divergencies from the unimolecular law in the velocity of reactions brought about by enzymes.

The concluding chapter on "oxidising processes and certain complex systems" is of the nature of an addendum and is very meagre. About one page is devoted to "the chlorophyll function"; and here there is no mention of Baly's recent work (1921, 1922). Under hydrolysis of starch there are six lines of ancient history.

Although the writer has criticised this book to some extent, he is aware that the author could not, in the space at his disposal, produce an exhaustive treatise. What is written is, for the most part, excellent and to the point. A useful feature in the bibliographical table is that, in addition to giving a reference to original papers, the particular page of the monograph on which an author's work is cited is also given. There can be no doubt whatever concerning the general value of the book as one with which no analytical chemist can afford to dispense.

ARTHUR R. LING,