NOVEMBER, 1926. Vol. LI., No. 608.

THE ANALYST

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

An Ordinary Meeting of the Society was held at the Chemical Society's Rooms, Burlington House, on Wednesday, October 6th, 1926, Mr. E. Richards Bolton, F.I.C., President, being in the chair.

Certificates were read for the first time in favour of Miss Gertrude Garland Andrew, B.Sc., Messrs. Charles Edward Barrs, F.I.C., Thomas Hedley Barry, Gordon Watson Douglas, B.Sc., Clarence Victor Forriss, B.Sc., A.I.C., and Reginald Charles Pakes, B.Sc.

A Certificate was read for the second time in favour of Mr. Stafford Aston, F.I.C.

The following were elected Members of the Society:—Messrs. Francis Harrold Banfield, M.Sc., Ph.D., A.I.C., and Albert Lester Williams, A.I.C.

The following papers were read and discussed:—"On the Presence of Compounds of Arsenic in Marine Crustaceans and Shell Fish," by A. Chaston Chapman, F.I.C., F.R.S.; "On the Presence of Lead and other Metallic Impurities in Marine Crustaceans and Shell Fish," by A. Chaston Chapman, F.I.C., F.R.S., and H. Linden; "The Examination of Fish for Formaldehyde," by Arnold R. Tankard, F.I.C., and D. G. T. Bagnall, A.C.G.F.C., A.I.C.; "The Potentiometric Titration of Tin with Potassium Bromate," by Karl Sandved; and "The Determination of Nicotine in Tobacco," by R. R. T. Young, M.Sc.

Death.

We regret to have to record the death of Mr. J. J. Broadbent, on February 27th, 1926.

On the Presence of Compounds of Arsenic in Marine Crustaceans and Shell Fish.

By A. CHASTON CHAPMAN, F.I.C., F.R.S.

(*Read at the Meeting, October* 6, 1926.)

A good many years ago in connection with some investigations arising out of the beer poisoning episode in the North of England I made the observation that the arsenic present in brewers' yeast did not exist entirely in the simple form in which it occurred in the wort from which it was derived. As a result of this observation I was led to the conclusion that the arsenic functioned in some way in the metabolism of the cell, and that as a result of the life processes a more or less complex organic arsenic compound had been built up. Whether this was an attempt on the part of the cell to diminish the toxicity of the arsenic, or whether the cell actually found a certain proportion of arsenic favourable to its development, it was, of course, impossible to say, but I was led to the conclusion that even if the latter were not the case, arsenic below a certain concentration did not appear to be particularly harmful to any of the vital activities of the cell, so far as these were known. A number of observations on this point have been made from time to time during the past twenty years, and a few experiments which I have made much more recently may be described in a future communication.

Arsenic in Marine Algae.—The question of the taking up and possible utilisation of arsenic by the cell would probably have ceased to occupy my attention had it not been for the more recent discovery that certain marine algae contain very heavy traces of arsenic, and that this appeared to exist, partly at least, in the form of a complex arsenic compound. This induced me, a few years ago, to take up the subject again in a more systematic manner, and I was led to the examination—among other things—of a number of different kinds of shell fish—using this expression in its widest and most popular sense. It is to the recording and discussion of these results that the present paper is mainly devoted.

It is difficult to say by whom the first observations as to the existence of heavy traces of arsenic in marine algae were made, but for a certain purpose I have, myself, regularly examined samples of Irish moss, agar, and other edible seaweeds during the past four or five years. So far as I am able to ascertain, the first published paper dealing at all comprehensively with this subject is that of A. J. Jones (*Year Book of Pharmacy*, 1922, p. 388). In an interesting paper entitled "The Arsenic Content of some of the Marine Algae," this author gives a number of results for various seaweeds, showing that in the case of 11 varieties the amounts of arsenic (expressed as arsenious oxide on the air dry substance) varied from 6 to 125 parts per million. I may say at once that, so far as I have dealt with similar materials, I can confirm these results.

In prepared seaweed Jones's numbers varied from 5 to 11 parts per million, and in certain medicinal seaweed preparations from 1 to 90 parts per million. Inasmuch as certain of these seaweeds (especially Irish moss) are used in the preparation of articles of food, as well as in medicine, the importance of these figures is apparent. In my own examination of Irish moss, extending to a very large number of samples, most of which had been carefully selected, and some of which had been washed or otherwise treated, the amounts of arsenic found have varied from about 7 to about 20 parts per million, but even the latter figure is occasionally exceeded. I shall return to this subject later.

Occurrence of Arsenic in Plants and Animals.—Among those who have devoted attention to the natural occurrence of traces of arsenic in plants and animals, the names of Gautier and Bertrand are deserving of special mention. Over a period of more than 20 years these chemists, and Gautier in particular, have devoted attention to this subject, and have succeeded in showing how very widely distributed traces of arsenic are. Although their statements—especially so far as they relate to the normal occurrence of traces of arsenic in the organs of the human body—have not passed entirely without challenge, there can be no reasonable doubt as to their substantial accuracy. The precise part, if any, played by these traces of arsenic in metabolism is very uncertain, but it is, I think, exceedingly probable—and my own experiments appear to support this view—that the arsenic occurs in organic combination, and does play some part in connection with the vital activities of the cell. Experimental difficulties must certainly be held responsible for the failure of some observers to find traces of arsenic in certain plant and animal tissues, but in the case of animals there can be little doubt that one of the main causes of discrepant statements is to be ascribed to differences in the food taken.

Arsenic in Fish.—In the examination of fish a certain amount of work has been done, but with one or two exceptions, to which reference will be made, the examination of shell fish and crustaceans, with which I am chiefly concerned in this communication, appears to have received very little attention.

In a paper by Bertrand, published in 1902 in the *Comptes Rendus*, this subject is dealt with, and it is pointed out that the amount of arsenic present in some fish is greater than had been supposed. With this exception, the subject does not appear to have attracted attention until quite recently. About the year 1923 a joint chemical and medical commission, appointed by the Swedish Government to investigate the general question of poisoning by arsenic, expressed, *inter alia*, the opinion that fish contained larger amounts of arsenic than had been hitherto suspected, thus confirming the earlier statement of Bertrand.

In 1924 the Ministry of Agriculture and Fisheries issued a publication entitled *Fishery Investigations*, Series 2, Vol. VI, No. 4, in which there are reports by several scientific men describing experiments made with the object of ascertaining the causes of the unusual mortality among oysters in English beds during the years 1920 and 1921. In the course of this work, some of which was carried

out in the Government Laboratory, it was found that the amount of arsenic in the edible portion (wet) of the oyster varied from an undetectable amount to 6 parts per million. From these results of the Government chemists, considered in conjunction with the observations of J. H. Orton and others, the conclusions were arrived at that arsenic is almost invariably found in the oyster, but that whether it was to be regarded as a normal constituent or not seemed doubtful. Thus, Orton says "Samples of oysters from the Thames estuary should be analysed periodically for arsenic for a year or two until it is made clear or otherwise that arsenic is normally present in oysters, and until more information on the rôle of arsenic in oysters is obtained." It may, perhaps, be mentioned that the average amount of arsenic found in the oysters examined in the Government Laboratory was about $\frac{1}{80}$ grain per pound.

This work appears to have been done in the year 1922, although, as mentioned, the results were not published until 1924.

In November of that year a paper was read before the Society by H. E. Cox consisting primarily of a criticism of the Ramberg method for determining very small quantities of arsenic, but dealing, incidentally, with the occurrence of traces of arsenic in fish and in urine. In this paper (ANALYST, 1925, **50**, 3) allusion is made to the reports of the Swedish Commission to which I have referred above, and it is pointed out that in the case of 11 different kinds of fish caught in British waters, and 6 caught in Swedish waters, the amount of arsenic varied from a minimum of 0·1 part per million to a maximum of 3·0 parts per million as determined by the Ramberg method, plaice being distinctly the highest in this respect. In this connection it may be said that the results given by the Ramberg method would seem, in all cases, to have been appreciably higher than those given by the method recommended by the Joint Committee in this country some years ago.

Cox further calls attention to the fact that normal urine, especially in the case of persons who have eaten considerable quantities of fish may contain quantities of arsenic (as much as 0·58 milligramme per litre) such as had previously been thought to be associated only with chronic arsenical poisoning, and that the eating of fish, and especially plaice, may cause the appearance of considerably increased quantities of arsenic in the urine within twenty-four hours.

In view of the presence of distinct traces of arsenic in seaweed and in fish I thought it would be of interest to ascertain what quantities of arsenic were likely to be met with in other marine organisms, and I turned my attention, in the first place, to certain of the shell fish and crustaceans. The results very soon showed that the subject demanded a much greater amount of attention than I had originally designed to give to it, and eventually I decided to include a study of all the better known shell fish and crustaceans which are used for food purposes. My results can, I think, best be given under the headings representing the various animals in question, and all the numbers in the paper, unless otherwise stated, are expressed in terms of arsenious oxide, and in parts per million of the edible portions, wet or dried, as the case may be. I have not thought it necessary, as

a rule, to give the amounts of arsenic expressed on the moisture-free material, but for all practical purposes these may be obtained by multiplying the numbers for the wet substance by four.

OYSTERS.—As mentioned above, the amount of arsenic in oysters has already received some attention in the investigation made for the purpose of arriving at the cause of the great mortality of oysters in the British beds during the years 1920 and 1921, but except in one case where arsenic had actually been added to the water for experimental purposes, the amount present does not appear to have exceeded 6 parts per million on the wet substance.

Five samples of the best British oysters, representing in each case an average of a dozen, and purchased on different occasions, gave the following results:—

No.	1	2	3	4	5
Parts per million (wet substance)	10	4·4	5	3	5

It will be seen that the difference between No. 1 and Nos. 2, 3, 4 and 5 is very great, but it may be said at once that an inspection of these oysters failed to reveal any departure from the normal. They seemed to be equally healthy and of equally good appearance, but they had a distinct metallic taste, which was probably due to the presence of heavy traces of other metals.

PORTUGUESE OYSTERS (*Ostrea angulata*).—These oysters are, as is well known, larger and coarser in appearance than the English Natives, and are said to be able to adapt themselves much more readily to an unfavourable environment.

Four samples of these, representing in each case an average of 12 specimens, gave the following results:—

No.	1	2	3	4
Parts per million (wet substance)	33	70	40	36

It will be seen that the general average for these oysters would appear to be much higher than in the case of the Natives.

Among these Portuguese oysters were some which were apparently diseased or, at any rate, possessed an unusual and unpleasant appearance. These, on examination, showed practically the same amounts of arsenic as were present in the obviously healthy individuals. It would seem, therefore, that the arsenic cannot, in this instance at least, be regarded as having been responsible for the "sickness" of the oysters.

ESCALLOPS.—Of these, which belong to the same natural family as the oyster, 8 samples were examined:—

No.	1	2	3	4	5	6	7	8
Parts per million (wet substance)	40	36	43	36	40	42	85	36

In the course of these experiments different parts of the escallops were examined separately, but the proportion of arsenic was found to be practically uniform throughout the organism.

MUSSELS.—Six samples of these bivalves, representing an average of about two dozen specimens in each case, were examined:—

No.	1	2	3	4	5	6
Parts per million (wet substance)	119	100	119	70	40	36

It will be seen that these results are extraordinarily high, a fact which may not be unconnected with the occurrence of the poisoning symptoms known as *mytilism*, which frequently follow the eating of mussels, and which were originally ascribed by Salkowski and Brieger to the presence of a poisonous alkaloid, to which the name "mytilo-toxin" was given.

COCKLES.—Six samples, representing an average of about six in each case, were examined:—

No.	1	2	3	4	5	6
Parts per million (wet substance)	40	20	20	17	20	36

WHELKS.—Six samples of the mollusc were examined, representing an average of about six specimens in each case:—

No.	1	2	3	4	5	6
Parts per million (wet substance)	29	20	40	12	20	24

PERIWINKLES.—Six samples were examined, representing an average of about twelve specimens in each case:—

No.	1	2	3	4	5	6
Parts per million (wet substance)	29	24	40	20	36	20

LOBSTERS.—Six different specimens were examined, varying in weight from 2 to 5 lbs. Of these, three had been boiled, whilst three were purchased alive in order to serve as a check on the results obtained in the case of the boiled specimens. In the case of the three boiled specimens the following numbers represent the amounts of arsenic in the edible portions, that is to say, the flesh of the back, the tail and the claws. This represents roughly 50 per cent. of the whole weight of the lobster as purchased:—

No.	1	2	3
Parts per million (wet substance)	36	36	40

Each of these three lobsters weighed between $2\frac{1}{2}$ and 3 lbs.

In No. 1 and No. 2 determinations were also made of the amount of arsenic in other than the edible portions, with the following results:—

No.	1	2
Parts per million (wet substance)	36	18

As mentioned above, the three living lobsters were examined as a check on the results for the boiled specimens, as it was thought possible that there might have been an accumulation of arsenic in the bought lobsters due to contamination

from the liquor in which they had been boiled. Of these, one is referred to as "No. 4," weighing 3 lbs., and the other two (weighing 5 lbs. together) as "No. 5."

Lobster "No. 4," having been killed, was boiled for 20 minutes in distilled water, and the determinations were made on the combined edible portions of the flesh in the usual manner.

Lobsters "No. 5." The two lobsters were killed, and portions of the flesh from the back, claws and tail were removed for examination, the remainder of the animals being then boiled for 20 minutes in distilled water, and portions of the boiled flesh similarly examined. The numbers below show the results for the unboiled and the boiled flesh respectively:—

		Wet substance. Parts per million.
No. 4	.. ..	31
No. 5.	Flesh from back, unboiled	110
	Flesh from claws ,, ...	110
	Flesh from tail ,, ...	110
	Flesh from back, boiled	105
	Flesh from claws ,, ...	105
	Flesh from tail ,, ...	105

It will be seen from these results that the process of boiling appears to have no material effect upon the amount of arsenic contained in the lobster.

The following further determinations were made in the case of these two lobsters:—

	Wet substance. Parts per million.
Internal organs other than the stomach—mainly liver ..	36
Contents of stomach	17

It may be mentioned that one of the living lobsters (No. 4) exuded from a claw accidentally broken, a quantity of white viscid liquid which, on examination, was found to contain approximately the same amount of arsenic (expressed on the dry substance) as the moisture-free edible flesh.

It is well known that lobsters are liable to disagree with many persons, and it has usually been assumed that this is due to the indigestibility of the flesh, owing to the density and coarseness of the muscular fibres. Having regard, however, to the above results, it would seem not impossible that the gastric and other disturbances which sometimes follow the eating of lobster may be due to the amount of arsenic which they contain. This point will be referred to again in this paper, and will be dealt with in greater detail in a future communication.

"Dublin Bay Prawns."—This is apparently the trade name for *Nephrops Norvegicus*. They belong to the same family as the common lobster, and are sometimes known as "Norway Lobsters." They measure, on an average, about 9 inches from the tail to the end of the claws, and weigh about one pound each.

Six specimens were examined, and in each instance the arsenic was determined both in the edible portion and in the combined internal organs. The following

are the results of which *a* represents the edible flesh, and *b* the internal organs:—

No.	1		2		3	
	a	*b*	*a*	*b*	*a*	*b*
Parts per million (wet substance)	38	20	45	29	40	24

No.	4		5		6	
	a	*b*	*a*	*b*	*a*	*b*
Parts per million (wet substance)	100	70	47	46	70	46

An examination of the shell showed 5 parts per million in one specimen, and 7 parts per million in another.

It will be seen from the above that this crustacean, like the ordinary lobster, contains a considerable amount of arsenic, and, further, that there is, in all cases, less in the internal organs than in the edible flesh. It will be seen, however, that there is no apparent connection between the two numbers.

PRAWNS.—Six samples were examined, which in each case represented an average of about two dozen specimens:—

No.	1	2	3	4	5	6
Parts per million (wet substance)	63	40	36	36	174	80

It is evident that the average amount of arsenic in these crustaceans is very considerable, and one sample shows a larger amount than any other specimen of either shell fish or crustacean which I have examined, namely, 174 parts per million, or 1·2 grains per lb. of the wet edible flesh.

An examination of the wet spawn, taken from specimens forming samples Nos. 3 and 4, showed it to contain 67 and 63 parts per million respectively, amounts which, it will be seen, are considerably greater than were present in the flesh of the specimens in question. Prawns, like lobsters and certain other crustaceans and shell fish, are, as is well known, prone to disagree with many persons. This has been variously ascribed to the formation of certain toxins in the prawn, or to the consumption of the contents of the alimentary canal. In view of these results, however, it would appear not impossible that the arsenic compound which they contain may be, in part at least, responsible.

SHRIMPS.—Eight samples in all were examined, which represented an average in each case of about three dozen specimens:—

No.	1	2	3	4	5	6	7	8
Parts per million (wet substance)	17	20	29	12	20	24	40	28

From the above results it will be seen that the average amount of arsenic, although large, is considerably less than in the prawns examined.

CRABS.—Six specimens were examined, with the following results, expressed on the edible flesh:—

No.	1	2	3	4	5	6
Parts per million (wet substance)	40	45	36	47	70	36

CRAWFISH OR SPINEY LOBSTER (*Palinurus vulgaris*).—This, like all the shell fish and crustaceans already dealt with, is a marine species, and must not be confounded with the crayfish (*Astacus pallipes*), which is found in fresh water only.

Five samples were examined, three consisting of a single specimen, and the remaining two (No. 4 and No. 5) representing the average of fourteen.

No.	1	2	3	4	5
Parts per million (wet substance)	45	40	20	28	28

A sample of spawn from No. 2 contained 70 parts per million, which is, it will be seen, as was the case with the prawn, considerably greater than the amount in the edible flesh.

The stomach contents of specimens No. 1, No. 2, and No. 3 were also examined, with the following results:—

No.	1	2	3
Parts per million (wet substance)	20	24	10

From the above results it will be seen that all the shell fish and crustaceans examined contained considerable amounts of arsenic, the quantities (expressed as As_2O_3) varying from a minimum of 3 parts per million ($\frac{1}{48}$ grain per lb.) in the case of one of the oyster samples to a maximum of 174 parts per million (1·2 grains per lb.) in one of the samples of prawns. It may be useful once again to emphasise the point that these results apply, in all cases, to the edible portions of the animals in the condition in which they are usually eaten.

In the case of crustaceans, it may be taken that the arsenic, expressed in terms of the whole animal—that is, with its shell—would be about half the amounts indicated in the above tables.

ARSENIC IN SEA WATER.—Having established the widespread occurrence of arsenic compound in these organisms, it was obviously a matter of importance to obtain some light on the origin of the arsenic. It is known that sea water contains very appreciable quantities of arsenic, and that the same is occasionally true of river water. Thus, as long ago as 1903, Gautier (*Compt. rend.*, 1903, **137**, 232 and 374) recorded the presence of arsenic in the water of the Atlantic Ocean in the neighbourhood of the Azores, and in sea water taken from the coast of Brittany and elsewhere, his result being in one case as high as 0·08 mgrm. per litre.

I thought it would be interesting to see what results my own experiments would yield, and 16 samples of sea water were collected at various points within a radius of about 4 miles of the Nore Lightship. This area was selected inasmuch as it embraces the water of the Thames and Medway estuaries, and is an area in which many of the crustaceans in question are caught. The results, expressed in parts per million, varied from a minimum of 0·14 to a maximum of 1·0, the average of the whole 16 samples being 0·33 part per million, or approximately $\frac{1}{40}$ grain per gallon. One or two samples of clean river water which I have examined have been found to contain only minute traces. In this connection it may be of some interest to note that it is recorded in the Annals of the Philosophical

Club of the Royal Society that at the meeting held on February 24th, 1870, Prof. Frankland said "that river water contained an appreciable quantity of arsenic. In Lancashire he attributed it to the iron pyrites used in the alkali works, and had estimated that thus 1500 or 1600 tons of arsenic were introduced yearly into Great Britain. He had found the metal in the London sewage at Barking to the amount of 0·004 in 100,000 parts, and accounted for its presence by the large consumption of coal in the Metropolis, from which the arsenic passed off in smoke, for he found it even in London rainwater to the extent of 0·008 in 100,000 parts."

It is, I think, quite evident that, whatever may have been the original source of the arsenic, it is from the sea water that the organisms dealt with in this communication have derived the arsenic they contain. Inasmuch as the amount of arsenic present in these marine shell fish and crustaceans is so greatly in excess of that present in ordinary sea fish, it would appear either that they find this element useful in connection with their life processes, or, alternatively, that they are less able than ordinary fish to eliminate it.

Flat Fish.—So far as fish generally are concerned, I have already referred to the results recorded in the report of the Swedish Commission, as well as by H. E. Cox, and these are confirmed by the few experiments I have myself made. Thus, I have found in five specimens of flat fish the following results:—

		Wet substance. Parts per million.
Plaice.	No. 1	10
	No. 2	6
Sole		7
"Dab" from estuary of Medway.	No. 1	3
	No. 2	4

A sample of Russian caviare was found to contain 5 parts per million, expressed on the wet substance.

It is interesting to note that the two "dabs" and the sole were taken from the same net, which contained, in addition, some shrimps. These shrimps, on analysis, were found to contain 40 parts of arsenic per million, or nearly 6 times as much as in the sole, and 10 times as much as was present in the "dabs." The water in which these were caught contained 0·28 part arsenic (as arsenious oxide) per million.

Experiments as to the Condition of the Arsenic.—Having regard to the amounts of arsenic present in these shell fish and crustaceans, it is obvious that it cannot be present as arsenious oxide, or in a form having anything like the same toxic activity. In order to obtain, if possible, some information on this point experiments were made in the direction of submitting the dried material to extraction with various solvents. A considerable amount of boiled lobster flesh was dried in an electrically heated oven, and when dry was ground to a fine powder. This powder, after the destruction of organic matter by means of acids in the usual manner, was found to contain 67 parts per million of total arsenic as arsenious

oxide. When aqueous extracts of this powder were added directly to the Marsh-Berzelius flask only negligible traces of arsenic were given off, and when the powder was heated with dilute hydrochloric acid to boiling for about 15 minutes under a reflux condenser, a mirror corresponding with only 8 parts per million was obtained. With caustic soda the result was even lower. It will be seen, therefore, that the arsenic does not exist in the lobster in a form in which it is directly amenable to the reducing action of hydrogen.

The same lobster powder was then examined with the object of ascertaining the amounts of extracted matters yielded to various solvents, and these extracts were subsequently examined for arsenic. The following table shows the results obtained:—

Dried Lobster Powder containing 67 parts of Arsenic (as arsenious oxide) per million.

	Extract percentages.	Arsenic (as arsenious oxide). Parts per million.
Water extract	—	0
Alcohol extract	36·6	60
Petroleum spirit extract	16·7	0
Extracted by ether from alcohol extract ..	12·4	3
Extracted by water from alcohol extract ..	19·6	63
Acetone extract	15·4	63
Chloroform extract	12·0	5
Acetone extract treated with chloroform and filtered. Chloroform extract	13·2	50

From the above results it will be seen that practically the whole of the arsenic is extracted by alcohol and by acetone, and that from the alcohol extract practically the whole can be again extracted by water.

As in the case of the total arsenic, the amounts of arsenic shown in the above table as having been extracted by various solvents are, in all cases, expressed on the dry lobster powder.

From the earlier experiments with water extraction I concluded that the arsenic compound in the lobster was insoluble in water, but further experiments showed that this was not the case, and that the failure to obtain the arsenic by simple water extraction was largely due to the protective effect of fat, of which the lobster contains, as is well known, a considerable amount. It may be useful to repeat that in all cases destruction of organic matter by heating with sulphuric and nitric acids is essential, since the arsenic in the form in which it occurs in the lobster is not reduced by hydrogen in the generation flask.

The above experiments were made in the hope that the arsenic might be concentrated to such an extent that some information as to the chemical nature of the arsenical compound or compounds present could be obtained.

CONCENTRATION OF THE ARSENIC.—After many attempts the following method was found to give the best results in respect of the concentration of the arsenic.

The dried lobster powder (containing 67 parts of arsenic per million) was first extracted thoroughly with dry ether in a large Soxhlet apparatus, for the purpose of removing the fat. This extract, amounting to 12·5 per cent., contained only about one part per million of arsenic. The extracted residue in the Soxhlet was then boiled with water for about 15 minutes, filtered, and the filtrate evaporated to dryness. The dry extract so obtained, amounting to only 3 per cent. of the weight of the powder originally taken, contained practically the whole of the arsenic present in the original material, that is to say, about 13 grains (as arsenious oxide) per pound.

It would seem from these experiments that the arsenic compound present in the lobster is a more or less complex organic substance, or mixture of substances soluble both in alcohol and in water. It is evidently possessed of very slight toxic properties as compared with those of arsenious oxide, and is sufficiently stable to resist the action of hot dilute hydrochloric acid or 5 per cent. sodium hydroxide solution. Beyond this it is impossible at the moment to go, but further experiments, both on the chemical and physiological sides are in progress, and with these I hope to deal in a future communication. It is obvious that very large quantities of the original material will have to be worked up in order to obtain a sufficient amount of the actual arsenical compound to admit even of its approximate identification and fuller study.

Experiments made by acting on the lobster flesh with trypsin and with peptase respectively, did not afford any indication that there had been any breaking down of the arsenic compound, and, although this was found to be in solution, it still failed to yield its arsenic when added directly to the Marsh-Berzelius flask.

Snails, Fresh Water Crustaceans and Fish.—In view of the quantities of arsenic compounds present in cockles, whelks, periwinkles and other marine shell fish, it seemed of interest, for comparison purposes, to examine one or two organisms of similar character, but having their habitat on land or in fresh water. The specimens examined were the garden snail, the French edible snail (escargot), and the crayfish, and to these were added a few specimens of fresh water fish:—

		Wet substance.
No. 1.	Garden snail	0·4 part per million
No. 2.	,, ,, ...	0·4 ,, ,, ,,
No. 3.	French edible snail	0·5 ,, ,, ,,

Four samples of crayfish were examined, each of which represented an average of three specimens weighing about 25 grms. each.

No.	1	2	3	4
Parts per million (wet substance)	1·4	1·0	1·0	2·0

Five specimens of fresh water fish were examined, and gave the following results:—

	Pike.	Perch.	Tench.	Bream.	Roach.
Parts per million (wet substance)	1	0·75	0·5	0·5	0·5

POTTED AND TINNED MATERIALS.—The following samples of potted and tinned materials were next examined:—

	Tinned prawns (American).			Tinned prawns (American).			Tinned crab (Japanese).	
No.	1	2	3	1	2	3	1	2
Parts per million (wet substance)	14	28	40	30	20	25	20	85

	Dressed crab.		Potted shrimps (English).			Tinned "crayfish."*		Tinned oysters (American).	
No.	1	2	1	2	3	1	2	1	2
Parts per million (wet substance)	83	25	16	25	11	20	17	1	0·5

* Probably some species of lobster.

ARSENIC IN SEAWEEDS.—At the beginning of this communication I referred particularly to the presence of arsenic in Irish moss and certain other seaweeds. It may, perhaps, be of interest to record the results obtained in the examination of a number of samples of specially selected Irish moss.

No.	1	2	3	4	5	6
Parts per million (as As_2O_3)	20	10	20	10	24	16

All the above numbers are expressed on the moisture-free material.

IDENTIFICATION OF ARSENIC.—The mirrors obtained in many of these experiments were examined, and the arsenic identified by the formation of the arsenious oxide crystals. In order, however, that no step might be left untaken, I decided in the case of the lobster to make a further experiment, working on a much larger quantity of material. Twenty grms. of dried lobster flesh were taken, and the organic matter was destroyed by treatment with sulphuric and nitric acids in the usual manner. After the removal of the acid, hydrogen sulphide was passed through the liquid, and the small amount of precipitate was collected on a filter paper and washed. The paper with the precipitate was then transferred to a flask containing about 200 c.c. of distilled water and was boiled for a considerable time in order to decompose the sulphide of arsenic, and, after filtration, the filtrate was titrated with 0·01 *N* iodine solution. The amount of arsenic so found corresponded with 64 parts per million, which is almost identical with the amount found by the Marsh-Berzelius method. The liquid, after titration with iodine, was evaporated to a small bulk, and submitted to the Reinsch test. A considerable deposit was formed on the copper, and this yielded, when heated, the characteristic sublimate of arsenious oxide crystals.

RATE OF EXCRETION OF THE ARSENIC.—I have referred in the early part of this paper to the fact that an increased excretion of arsenic in the urine has been observed to follow the consumption of certain fish, but, so far as I have been able to ascertain, the maximum amount recorded has been of the order of 0·6 mgrm.

per litre, or approximately $\frac{1}{24}$ grain per gallon. Inasmuch as these observations had reference to ordinary sea fish, I have thought that it would be interesting to ascertain what results would be likely to be met with after the consumption of some of the crustaceans or shell fish referred to in this paper. For the purpose of these experiments two persons, referred to as "A" and "B" respectively, were selected, and the crustacean employed was lobster. In the case of the person "A" one pound of lobster was eaten at one meal. The lobster in question contained 0·5 grain of arsenic (as arsenious oxide) per lb. of the wet edible flesh. The following results were obtained in the examination of the urine:—

	Arsenic (as arsenious oxide). Grain per gallon.
Average "normal" urine	$\frac{1}{170}$
Average for 12 hours following the consumption of the lobster ..	$\frac{1}{2}$
Average for following 24 hours	$\frac{4}{5}$
Average for following 12 hours	$\frac{7}{10}$

This person was known to be intolerant of shell fish and crustaceans generally, and in an earlier experiment, which could not be completed, experienced extreme discomfort and noticed one or two small areas of skin discoloration within a few hours of the meal.

In all the above specimens of urine only very small quantities of arsenic could be detected by adding the urine directly to the generating flask. When an attempt was made to ascertain what proportion of the total arsenic was excreted in this manner, it was found that, of the 33 mgrms. (expressed as arsenious oxide) present in the one pound of lobster eaten, 24·3 mgrms. were recovered in the above samples of urine, leaving 8·7 mgrms. unaccounted for. This, of course, does not claim to be anything more than a rough experiment, but it shows, I think, that the greater part of the arsenic is excreted in the urine and within a comparatively short time of the consumption of the food. Of the 24·3 mgrms. referred to above, a total of only 0·9 mgrm. could be determined directly, that is to say, without oxidation with nitric and sulphuric acids.

In the case of "B" no discomfort whatever was experienced as a result of the experiment, and the following numbers were obtained. Seven specimens of urine were examined in all.

		Arsenic (as arsenious oxide). Grains per gallon.
No. 1.	Taken 12 hours after a meal of salmon	$\frac{1}{50}$
No. 2.	Taken 48 hours later	$\frac{1}{90}$
No. 3.	Taken 12 hours later	$\frac{1}{100}$

At this stage $\frac{1}{2}$ lb. of lobster flesh was eaten at one meal, and the following samples were collected and examined:

No. 4.	Six hours after the consumption of the lobster	$\frac{1}{80}$
No. 5.	Average of the following 12 hours	$\frac{1}{3}$
No. 6.	Twelve hours later than last portion of No. 5	$\frac{1}{17}$
No. 7.	Forty-eight hours later	$\frac{1}{80}$

In order to obtain definite information as to the amount of arsenic ingested, the remaining half of the same lobster was examined, and was found to contain 0·25 grain arsenic per pound of the wet edible flesh.

It will be seen that not only was the amount of lobster eaten by "A" twice as great as that eaten by "B," but that the "A" contained twice as much arsenic as the "B" lobster. This, no doubt, accounts for the fact that the urine in the former case contained much larger quantities of arsenic than in the latter, and that the duration of the period of most pronounced excretion was considerably longer. The "B" results have, I think, an additional interest in that they have reference to the consumption of salmon as well as lobster. Thus, there was a slight rise following the consumption of the salmon, the number quickly dropping down to what may be regarded as the "normal," namely, $\frac{1}{100}$ grain per gallon. This, it will be seen, was followed by a slight rise 6 hours after the eating of the lobster, and the amount excreted increased during the next 12 hours to as much as $\frac{1}{3}$ of a grain per gallon. After this, the amount fell (No. 7) to what may be roughly regarded as "normal." Here, as in the case of the person "A," only a very small proportion of the arsenic could be detected directly, that is to say, without destruction of the organic matter by nitric and sulphuric acids. Whether the arsenic was present in all these specimens of urine in the form in which it occurred in the lobster it is, of course, impossible to say, but it is clear, at any rate, that in its passage through the organism the arsenical compound had not been broken up sufficiently to render it amenable to the direct reducing action of hydrogen in the Marsh-Berzelius flask. This is in accordance with the results of the experiments previously referred to, which showed that when the lobster flesh was acted upon by trypsin and by peptase respectively, although the protein matter was rendered completely soluble, the arsenic was still in a form in which it could not be detected directly. The bearings of this fact upon the physiological, as well as upon the toxicological aspects of the matter, will be obvious, and are, I think, of considerable importance.

PHYSIOLOGICAL QUESTIONS.—Further experiments, having for their object the isolation, or at least the concentration of the compound or compounds of arsenic present in these crustaceans, as a preliminary to the study of their physiological properties, are in progress. Whether the arsenic compound or compounds are possessed of a low order of toxicity, or whether they are even non-toxic—using the word "toxic" in its ordinary sense—I cannot, of course, say. It seems, however, not impossible that the unpleasant consequences which occasionally follow the consumption of crustaceans and shell fish may not be unconnected with the presence of these compounds. As is so often the case, there may be marked individual idiosyncrasies, and, in addition, certain persons may have the power of breaking down the arsenic compound to a greater extent than others in the course of its passage through the organism. It is obvious that this aspect of the question will need a very considerable amount of investigation before anything more definite can be said about it.

I desire to offer my best thanks to my assistant, Mr. H. Linden, to whom I am greatly indebted for the carrying out of the majority of the very large number of arsenic determinations involved in this enquiry, and for the great interest he has taken in the work throughout. I also desire to express my thanks to my assistant, Mr. F. A. Hatch, A.I.C., for valuable help.

CHEMICAL LABORATORIES,
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DISCUSSION.

THE PRESIDENT complimented the author on the paper, and, commenting on the amount of work it had involved, observed that no avenue seemed to have been left unexplored. He was, himself, specially interested in the reference to Dublin Bay prawns; calculating the amount of arsenic one consumes when partaking liberally of prawns, it would appear likely to amount to a toxic dose, but apparently the arsenic was not present in a toxic condition.

Mr. J. WEBSTER said that the paper was most full and interesting, and contained some surprises. The difference between the percentage of arsenic in salt-water and fresh-water fish, was, to some extent, expected, but the amount was rather a surprise. He was particularly interested in the tables showing the excretion of arsenic, and asked exactly what the author meant by "average normal urine"? Was the figure given that of a specific case, because, in his experience, 1/170th of a grain per gallon was abnormal for human urine? The figures for the rate of excretion were the usual ones. He agreed as to the unreliability of the Marsh test without preliminary destruction of organic matter.

Dr. H. E. COX observed that the more investigations there were into the presence of arsenic the greater the quantity found became. He thoroughly agreed with what had been said as to the absolute necessity for the complete destruction of organic matter, and enquired whether the arsenic in sea-water was present in organic or inorganic form, and whether it was all given off in a direct Marsh-Bezelius test. Also whether there was any difference in the amounts of arsenic present in sea-water salmon and fresh-water salmon, or sea-trout and river-trout. Apparently in the higher organisms the cells were not so tolerant to arsenic as in the case of the lower organisms. With regard to urine, Thomson of Manchester did, in fact, find minute quantities in a few samples, but both he and others had reported it to be completely absent in normal cases, which fact could only be accounted for by supposing that the methods employed by the early workers did not completely destroy organic matter.

Mr. C. A. MITCHELL asked whether there was any evidence of excretion of arsenic by lobsters, or whether any experiments had been made to ascertain their limit of toleration. He also suggested that the compounds in the fish might possibly be arsenic proteins analogous to the definite silver proteins.

Dr. G. MONIER-WILLIAMS said that all these sea animals passed enormous quantities of water through their gills, and possibly these organs exercised selective absorption on small quantities of arsenic and heavy metals. Although fish could live in artificial sea-water in aquaria, natural sea-water must be added from time to time. The question whether heavy metals were necessary to fish, or whether they were incidentally absorbed, could perhaps be answered by observations carried out in marine aquaria.

Mr. E. T. BREWIS suggested that possibly the sea water near Portugal might contain more arsenic than that of the Nore. In Cornwall, too, there was much arsenic in the ores near the coast, which might be washed out to sea.

Dr. B. S. EVANS enquired whether there was any known difference in the rate of excretion of a substance that had a physiological effect on the body and one that had not. He also asked whether any observations had been made on lobsters of different ages, as this should settle the question as to whether or no the fish eliminated the arsenic compound.

Mr. R. C. FREDERICK pointed out that the paper indicated the necessity for an investigation as to the normal amount of arsenic in the intestines, stomach and other organs of the human frame.

Mr. A. CHASTON CHAPMAN, replying, said that some arsenic compounds were well known to have very low toxic activity, but he had carefully refrained from drawing any conclusions on the physiological side of the question. The word "normal" as typed was in inverted commas, the figure given for "normal" urine being the pre-experimental amount present in a specific case, and it was not intended to be regarded in any other sense. The meal of salmon to which he had referred was not an intentional part of the experiment, and the number was merely given as a possible explanation of why the amount of arsenic was as high as 1/50th grain before the eating of the experimental meal of lobster. He had not made any experiments either with salmon or with trout, nor was he prepared to offer any explanation as to why marine crustaceans and shell fish should contain higher proportions of arsenic compounds than ordinary sea fish, such as plaice and soles.

The arsenic in the sea water could, in most cases, be determined by direct experiment, but in some instances acid treatment was resorted to as a check on the results. The arsenic compounds present in the organisms with which he experimented were probably not protein in character, since their solubility appeared to be greater than might have been expected if such had been the case. He did not know the origin of most of the fish which he had examined, as they were purchased from various fishmongers in the ordinary way. He had not made any observations on the influence of age on the amount of arsenic compounds present in any of the crustacea with which he had dealt.

On the Presence of Lead and other Metallic Impurities in Marine Crustaceans and Shell Fish.

BY A. CHASTON CHAPMAN, F.I.C., F.R.S., AND H. LINDEN.

(*Read at the Meeting, October* 6, 1926.)

IN the course of the work described by one of us on the occurrence of arsenic in marine crustaceans and shell fish (see preceding communication), it was observed that these frequently contained traces of lead, copper and other metallic impurities. It had, of course, long been known that oysters contained heavy traces of copper and zinc, and it was felt that it would be interesting to ascertain to what extent the crustaceans and shell fish dealt with in the communication above referred to were contaminated with metallic impurities, and especially with lead.

Specimens of the following crustaceans and shell fish were examined:—

	Parts per million.	
	Copper.	Lead.
Lobster	167	6·2
,, ...	—	25·6
Prawns	—	7·5
Crab	130	17
Mussels	—	20
,, ...	—	10
Cockles	—	9·7
,, ...	—	1·3
Periwinkles	—	18
,, ...	—	7·2
Whelks	—	6·9
,, ...	—	5
,, ...	115	17·1

The above numbers are expressed on the dry material, but it may be take that, in all cases, the amounts of copper and lead present in the wet edible portion would be approximately one-fourth.

In the case of native oysters, lead was found to be present in the three sample examined, each of which represented about one dozen specimens. The result expressed on the dried edible portions, were 12 parts, 20 parts, and 400 parts pe million, respectively.

Five samples of Portuguese oysters were similarly examined, and found t contain the following amounts of lead, expressed in parts per million on the dr edible substance: No. 1, 21; No. 2, 10; No. 3, 25; No. 4, 307; and No. 5, 27.

It was not thought necessary to examine any of the oysters for zinc an copper, as this has been done by several workers, and numbers are recorded in th literature showing the presence of quantities of copper varying from 4 to 3300 and of zinc varying from 70 to 2100 parts per million. The highest numbers w have seen, both for copper and for zinc, are contained in the Report issued by th Ministry of Agriculture and Fisheries entitled *Fishery Investigations* (Series 2 Vol. VI, No. 4, 1924), and were obtained in the Government Laboratory.

Like the arsenic, these metallic impurities appear to have been derived from the sea water. The 16 samples of sea water, referred to in the above mentioned communication were examined for lead, and the results were found to vary from 0·12 to 1·0 part per million, the average being 0·4 part per million.

Incidentally, it may be of interest to record that samples of seaweed have been found to contain appreciable traces of some boron compound, apparently as a normal constituent. The seven samples examined gave the following results expressed as H_3BO_3 :—

	Per Cent.
Irish moss. No. 1	0·097
No. 2	0·076
Seaweed (*Fucus*)	0·04
Agar-agar. Nos. 1, 2, 3 and 4 ..	0·07, 0·16, 0·15, 0·13

All these numbers are expressed on the dry material.

CHEMICAL LABORATORIES, 8, DUKE STREET, E.C.3.

The Examination of Fish for Formaldehyde.

By ARNOLD R. TANKARD, F.I.C., and D. J. T. BAGNALL, A.I.C.

(*Read at the Meeting, October* 6, 1926.)

For some time past we have examined various kinds of fish, many of which were Norwegian herrings imported into this country in fine condition, for the presence of formaldehyde, alleged to be used as a preservative.

For our purpose it was obviously necessary to have a test which was specific for formaldehyde, and not merely one which indicated the presence or absence of reducing substances. We therefore adopted the method recommended by S. B. Schryver* (1909). We obtained affirmative results by this method with a considerable number of samples (60 per cent. of the fish examined), but the amount of formaldehyde indicated was usually only one or two parts per million. There was, however, nothing doubtful about the colour reaction, which, in most instances, was characteristically scarlet.

The minuteness of the amount and its almost constant quantity raised strong suspicions in our minds as to whether the reaction was really due to added formaldehyde, especially also as the use of any such chemical was strenuously denied by the Norwegian exporters. In view of the specificity of the phenyl-hydrazine test, it would appear that if added formaldehyde is not present in these imported fish (and this seems to be proved now by the fact, ascertained by us, that fish caught from British trawlers, and examined soon after landing, have also in all cases been found to give the reaction to approximately the same degree), some constituent of the flesh of fish, or a decomposition product formed during the course of the test-reaction, is responsible for the positive results obtained. Now trimethylamine is a characteristic constituent of fish, and is present (together with monomethylamine) in considerable amount in herring brine. We have therefore examined the possibility that this compound might be responsible for the positive results in the Schryver test. A very small quantity of a 33 per cent. solution of trimethylamine (B.D.H.) added to water showed negative results with the Hehner test and the Shrewsbury and Knapp test, but a definite reaction with the Schryver phenyl-hydrazine test. Purification of the trimethylamine by distillation with ammoniacal silver nitrate, to free it from any formaldehyde if present, gave a product which still responded strongly to the Schryver test. It

* Report to the Local Government Board (*Food Report* No. 9), 1909; "On the Application of Formaldehyde to Meat," Part II., "The Presence and Detection of Formaldehyde in Meat," S. B. Schryver.

In this test, which can be used for determining the amount of formaldehyde, meat is heated for 5 minutes in a boiling water-bath with water to which have been added, for each 10 c.c. water, 2 c.c. of a 1 per cent. solution of phenyl-hydrazine hydrochloride. The larger the quantity of formaldehyde present, the greater the volume of water used. The mixture is cooled, filtered through cotton-wool, and to 12 c.c. of filtrate are added 1 c.c. of a 5 per cent. solution of potassium ferricyanide and 4 c.c. of strong hydrochloric acid for each 12 c.c. water and phenyl-hydrazine reagent used in the test. The scarlet coloration develops quickly, reaches its full intensity after a few minutes, and lasts for several hours.

appeared possible that trimethylamine might be oxidised with formation of formaldehyde under the conditions of the test,* as shown below:

$$2(CH_3)_3N + O_2 = 2(CH_3)_2.NH + 2HCHO,$$

and further: $$2(CH_3)_2.NH + O_2 = 2CH_3.NH_2 + 2HCHO.$$

Experiments we have carried out show that trimethylamine is readily oxidised in this way on careful treatment in weak solution with hydrogen peroxide at a raised temperature. Thus treated, trimethylamine gave a product reacting eight times as strongly in the Schryver test as in its original unoxidised state; and the oxidised portion not only gave the scarlet coloured hydrochloride of the phenyl-hydrazine compound, but it also responded to the Hehner and Shrewsbury and Knapp tests for formaldehyde, which last-named reactions were not given by the unoxidised trimethylamine. On the other hand, the oxidation of trimethylamine with hydrogen peroxide may easily proceed beyond the formaldehyde stage, when this compound disappears and negative results with the Schryver test are then obtained.

Our results therefore lead us to the following conclusions:

(1) Fresh herrings and other fresh fish (cod, haddock, mackerel) may react to a specific test for formaldehyde, where oxidation is involved, showing one or two parts of the aldehyde per million of the fish, but such reaction is not necessarily due to added formaldehyde.

(2) The flesh of fish may give a positive reaction in the phenyl-hydrazine test for formaldehyde, owing to the oxidation of pre-existing trimethylamine, whereby (as we have proved) formaldehyde is produced.

(3) Fish exposed to the air till putrefaction has taken place does not give an increased reaction for formaldehyde; on the contrary, the reaction at first obtained tends to disappear with increasing decomposition.

(4) It is possible that our results may have some bearing on those of Dill and Clark (*J. Assoc. O. A. Chem.*, 1926, ix. 117; abst. ANALYST, 1926, 304). The reaction used by these workers is not mentioned in the abstract, but it is significant that appreciable amounts of formaldehyde were found by them in canned fish (crustacea and red rock cod) on distillation, even up to 1:30,000.

The work recorded in this paper was carried out in the Hull Corporation laboratories.

DISCUSSION.

Mr. E. HINKS said that the paper shewed the danger of placing too much reliance upon colour reactions. He recalled how, in 1912, there was a suspicion that certain Dutch cheeses contained formaldehyde. On treatment with hydrochloride acid cheese was liable to give a colour simulating that given by the Hehner test for formaldehyde. He had found that many cheeses gave also a distinct positive reaction when submitted to the Schryver process, and he came to the conclusion, from its widespread occurrence in cheeses from various sources, that this slight, but distinct, positive reaction was natural to many cheeses, and was not due to added formaldehyde.

* Addition of ferricyanide in the phenyl-hydrazine test oxidises the condensation product, first formed with formaldehyde, giving a weak base having a coloured hydrochloride.

Dr. G. MONIER-WILLIAMS, referring to the Schryver test, said that by extracting the colouring matter with ether, and re-extracting with hydrochloric acid, it was possible to obtain with the extract a coloration which was more easily compared with that given by formaldehyde itself, and which, if pure ether were used, was also more permanent.

The Electrometric Determination of the Acidity of Writing Inks.

BY HENRY ALDOUS BROMLEY AND A. DE WAELE.

THE acidity of an ordinary blue-black writing ink is important on account of its corrosive action on pens, which in some commercial varieties of ink is considerable. It is practically impossible to arrive at any satisfactory determination by the ordinary methods of chemical analysis, and resort must be had to electrometric titrations and to determinations of P_H values.

As it seems likely that the heterogeneous composition of these fluids, as well as the presence of charged colloidal particles, militates against the successful application of the hydrogen—platinum black—calomel electrodes, the possibility of applying the so-called quinhydrone electrode (the operation of which is more or less independent of these and other disturbing factors) has been investigated. Determinations by this method are much quicker than with the more orthodox apparatus, while the results appear to be consistent and reproducible.

The apparatus used is of quite a simple character, and most of it can easily be made in the laboratory. The arrangement will readily be gathered from the diagram reproduced, and the only real expense entailed is that for the milli-voltmeter (Cambridge Scientific Instrument Co.). The rheostat is a "radio" instrument costing half-a-crown.

For the determination of P_H values by this method 10 c.c. of the ink under examination are measured into a small beaker, and sufficient solid quinhydrone added to saturate the solution. Into another beaker of the same size are measured 5 c.c. of a standard "buffer" solution with a P_H value of about 6 to 7, followed by an equal volume of distilled water (preferably free from carbon dioxide) and quinhydrone to saturation. The solutions are allowed to stand for a few minutes, and junction between them effected by means of the usual bridge of saturated potassium chloride solution. The electrodes in each case consist of a spiral of stout platinum wire fused into the end of a short length of glass tube having a small bulb containing mercury. Contact with the platinum is made through the mercury by copper wires well amalgamated.

The milli-voltmeter, having a third terminal, answers the purpose both of determining the null point and of indicating the observed potential of the system when a balance has been obtained. Thus neither a Weston cell nor an electrometer is necessary for any but very exact measurements. The P_H value is found from the following formula:

$$P_H = \frac{E}{\cdot 0575} \pm K \text{ at } 16^\circ \text{ C.},$$

where K is the known P_H of the buffer solution used. There is a small temperature

co-efficient which may be neglected for ordinary work. Assuming that the test solution will usually be more acid than the "buffer," the sign of K will be negative.

Certain fairly obvious precautions are necessary in carrying out the method. No vaseline may be used on the stopcock of the capillary bridge, or electrical continuity may be seriously interfered with, while the capillaries themselves must be quite free from air bubbles and their external parts wiped dry before use. The electrodes must be washed in distilled water after every time of using, and burnt off in an alcohol flame after every two or three tests.

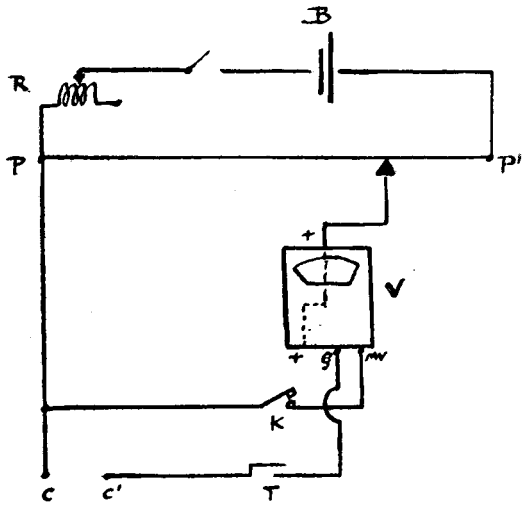


DIAGRAM OF ELECTRICAL CONNECTIONS.

B, battery (2 volts); R, rheostat (30 w); P P', "Eureka" wire (36 s w g), 1m. long; V, combined galvanometer and millivoltmeter reading to 1 volt; K, knife key; T, tapping key; C C', connections with gas chains.

Should it be found impossible to obtain the null point at any position of the resistance bridge slider, it may be concluded that either the buffer cell is higher in acidity than the test cell or that the P_H (E.M.F.) values of the two half cells exactly agree. The second alternative can be checked by eliminating the accumulator in the circuit and closing the part of the circuit comprising the two half cells and voltmeter, when a zero reading will prove this equality. Should, however, a reading be given under such circumstances, this indicates that the current from the two half cells has reversed its direction, owing to the P_H of the test cell being higher than that of the buffer cell. In that case mere reversal of the electrode connections will suffice to give a proper reading, and the sign of the K term in the equation becomes positive.

With the quinhydrone electrode measurements to an accuracy of 1 per cent. of P_H value can be obtained on tests of $P_H = 8$. Beyond this degree of alkalinity, however, the accuracy falls off rapidly.

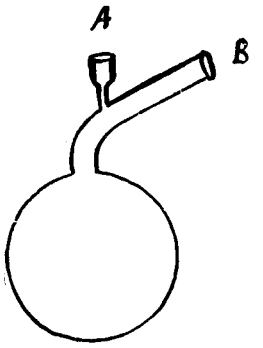
It is advisable to take readings immediately after junction of the electrolytes has been effected, *i.e.* before diffusion commences, or potential differences at the points of junction make themselves evident.

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.

A FLASK FOR THE RECOVERY OF VOLATILE LIQUIDS.

THE flask shown in the accompanying diagram has been devised in the writer's laboratory, and has been found extremely satisfactory for the recovery of volatile solvents such as ether, petroleum spirit, etc. When in use, B. is attached to the condenser, and A carries a well-cooled reflux condenser, by which means a loss of only about 5 per cent. of ether has been observed. The flask can also be employed for the recovery of liquids in the absence of moisture, in which case A carries a calcium chloride tube. The flask is manufactured in different capacities by Messrs. Plowden and Thompson, Ltd., Dial Glass Works, Stourbridge.



THE UNIVERSITY, BRISTOL. M. NIERENSTEIN.

THE USE OF THE POTASSIUM IODIDE AND IODATE METHOD FOR THE TITRATION OF KJELDAHL DISTILLATES.

DURING the course of some Kjeldahl determinations it was noticed that the titre of the blank experiment was greater than that of the same volume of acid titrated directly. The cause of this was suspected to be carbon dioxide. Accordingly three equal volumes of 0·1 *N* sulphuric acid (about 40 c.c.) were measured into three flasks. To the first potassium iodide and iodate were added, and the titration completed with thiosulphate. The second was thoroughly boiled to expel carbon dioxide, cooled, and then titrated with thiosulphate after the addition of potassium iodide and iodate. The third was saturated with pure washed carbon dioxide and then submitted to similar titration.

In the first two cases a sharp end point was obtained, and the same volume was required to combine with the iodine liberated, but in the third case it was found impossible to obtain an end point until at least 3 c.c. of 0·1 *N* thiosulphate solution had been added in excess of that required in titrations (1) and (2). Further, the discharge of the colour was not permanent, but slowly returned a few seconds after each addition of thiosulphate.

It thus appears that carbonic acid seriously interferes with the iodide-iodate method of titration, and, as it is almost certain to be present in Kjeldahl distillates, owing to slight carbonation of the strong sodium hydroxide solution used for neutralising, the only safe procedure seems to be to boil the distillate before the addition of the iodide and iodate and then titrate in the ordinary manner.

HAROLD F. WILSON.
F. MATTINGLEY.

Notes from the Reports of Public Analysts.

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

COUNTY BOROUGH OF SALFORD.

ANNUAL REPORT OF THE BOROUGH ANALYST FOR 1925.

DURING the year, 2264 samples were submitted for analysis, of which 1396 were taken under the Sale of Food and Drugs Act. These comprised 752 formal and 644 informal samples, of which 108 (7·7 per cent.) were adulterated. The number of samples per 100,000 persons was 572.

MILK.—Of the 921 samples, 43 were adulterated. A sample of milk from a shop was found to be 3·5 per cent. deficient in solids-not-fat, and 2 samples taken from the farmer supplying the shop were deficient to the extent of 5·9 per cent. An "appeal to the cow" sample gave good results, but an attempt was made during the visit to the farm to introduce water into the milk. Proceedings were instituted, and the farmer was fined £2.

One sample of milk contained potassium nitrate (1 part in 10,000), but the source of the adulteration could not be traced.

MARGARINE.—As a result of prosecutions for the sale of margarine containing minute proportions of butter but described as "compounded with butter," etc., the practice has ceased, and it is instructive to note that butter is no longer added to the margarines so described, thus showing that the amount of butter present would not have any effect on the flavour and was obviously added so that the word "butter" might be used.

A sample advertised as "Churned with Rich Cream" contained, at most, 1 per cent. of butter fat. The manufacturers of the product were approached, and after correspondence, agreed to withdraw the description rather than have the matter considered in the Courts.

CREAM ICE.—Eleven samples were examined, and, of these, 1 contained 15 per cent. of butter fat, 1 contained 9 per cent., and the remainder contained quantities varying from 1 to 6·7 per cent. of butter fat. Accepting the U.S.A. standard of 14 per cent. of butter fat for ice cream, only one of the samples could be classified as genuine. Apparently there have been no prosecutions for the sale of cream ice in this country, but it is unsatisfactory that articles sold under this name should contain less fat than is present in normal milk. The vendor of each unsatisfactory sample was cautioned.

JAM.—Two samples of strawberry jam returned as adulterated, were labelled, respectively, "Contents Guaranteed made from Finest-Selected Fruit and Pure Sugar" and "Made from Fresh Fruit and Refined Sugar only." The former sample contained 15 per cent. of glucose syrup, and the latter 5 per cent. In *Smith* v. *Wisden* it was held that there was no evidence to show that marmalade containing 13 per cent. of glucose was not marmalade, and this ruling would probably be followed in the case of jam, but only in cases where no suggestions of the nature of the jam were made. In the present cases, however, claims are made

or suggested that glucose is not added, and it would be necessary, therefore, for the Court to decide on the new facts. Both manufacturers gave an undertaking that they would alter their labels.

TOFFEE AND SWEETS.—Thirteen of 57 samples contained excessive quantities of sulphur dioxide and were returned as adulterated. The sulphur dioxide is not added as a preservative, but as a bleaching agent. At least two manufacturers whose products were examined gave a definite undertaking to discontinue the practice.

COD LIVER OIL AND MALT.—Two samples, stated to contain all the virtues of the original liquid preparation, without the unpleasant taste and stickiness, were found to contain cod liver oil which had been hardened and deodorised, probably by hydrogenation.

MEAT AND FISH PASTES.—Seven samples were examined, and some were found to contain starch. The addition is a fairly widespread custom in the trade, and, for the time, they were passed as genuine. One sample of anchovy paste yielded 14 per cent. of ash consisting mainly of iron oxide, added as colouring matter, possibly in the form of Armenian bole. It was condemned, but no further action was taken.

SEIDLITZ POWDER.—Eight of nine samples returned as adulterated were described as of "double strength." A sample was described as "extra strong"; it is not easy to decide to what type of powder these words are applicable. It would appear that it should be *appreciably* stronger than the B.P. article, and this view is supported by the fact that the B.P. Codex contains a formula for "extra strong Seidlitz powder," in which the amount of Rochelle salt is increased to half as much again as in the B.P. powder. The whole of the vendors were cautioned against such misdescription.

G. D. ELSDON.

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.

SALE OF LYSOL "FREE FROM CARBOLIC ACID."

CASE UNDER THE PHARMACY ACT AND DANGEROUS DRUGS AND POISONS (AMENDMENT) ACT, 1923.

ON September 9th a druggist's assistant was summoned at Edinburgh on a charge of selling "a quantity of carbolic acid and its homologues as an ingredient in a quantity of lysol, which is a liquid preparation containing more than 3 per cent. of carbolic acid and its homologues, and a poison within the meaning of Sec. 2 of the Pharmacy Act."

Mr. J. Rutherford Hill, Resident Secretary, Pharmaceutical Society, produced the carton and bottle of lysol, and pointed out that the word "poison," or the name of the poison, or the proportion of poison present, did not appear on the label. He stated that he had examined many samples of lysol, and that the one now

produced had all the characteristics of lysol. He had analysed the contents of the bottle and had found that it contained approximately 31 per cent. by weight of carbolic acid and its homologues, commonly known as cresols.

In cross-examination he admitted that he had observed that the bottle was labelled "poisonous," but that was the word required to be placed on substances under Sec. 5 of the 1908 Act which were not scheduled poisons. Scheduled poisons had to be labelled "poison," and this had not been done in this case.

He had not determined the amount of carbolic acid, but had no doubt that it was present. Commercial cresols prepared by fractional distillation from coal tar always contained a variable quantity of carbolic acid. What was called "commercial carbolic acid" was really commercial cresol. He had noticed the label on the carton that this lysol was free from carbolic acid, but was of opinion that it could not be strictly true, and was misleading. It was possible to prepare the mixed cresols practically free from carbolic acid, but that involved a complicated and costly chemical process which would not be adopted on any commercial scale.

Mr. A. Scott Dodd, B.Sc., F.I.C., City Analyst, stated that he had analysed the contents of the bottle and had found 31·2 per cent. of carbolic acid and its homologues, commonly known as cresols.

In cross-examination, he admitted that he had not tested the sample specially for carbolic acid, but it was well known that commercial cresol, such as was used in the manufacture of lysol, always contained some trace of carbolic acid. He had noticed the label on the carton to the effect that this preparation did not contain carbolic acid, but had not attached any particular importance to the statement.

In reply to the Sheriff, witness said that he had thought it sufficient to report that the preparation contained 31·2 per cent. of carbolic acid and its homologues, which he understood to be the statutory poison. He was unable to say whether there would be sufficient carbolic acid present to make the preparation poisonous.

The defendant admitted having sold the bottle of lysol, but said that he was not aware that he was doing anything wrong. He did not know that lysol was a poison. He had noticed the words "Free from carbolic acid" on the carton, but they did not convey any special information to him. He knew nothing at all about carbolic acid or the effects of carbolic acid.

The solicitor for the defence submitted that the case had not been proved. The prosecution had not stated what percentage of carbolic acid was present in the sample, and the label by the manufacturer stated that it was free from carbolic acid.

The Sheriff said that he did not think that the charge had been satisfactorily proved. The presence of carbolic acid in the preparation had not been proved, nor had it been proved that it was present in such quantity as to make the preparation poisonous within the Schedule. The carton was labelled "Free from carbolic acid," which, to an unskilled person, would suggest that in selling the preparation he was not selling carbolic acid. Only a skilled person would know the meaning of homologues of carbolic acid. He therefore found the charge not proven.

UNSOUND EGGS: A MAGISTRATE'S POWERS.

At the Kesle (Co. Fermanagh) October Petty Sessions a tradesman was prosecuted by the Irvinestown Council for exposing for sale 153 eggs alleged to be unfit for human food. It was brought out in the evidence that the sanitary officer had

made a complaint to a magistrate, who had ordered the eggs to be destroyed without having seen them.

The solicitor for the defence contended that in these circumstances there could be no conviction, as the magistrate was bound to see the eggs before he made an order for their destruction.

In reply to this, the prosecution contended that the magistrate was entitled to act as he did on the complaint of the sanitary officer, and, if satisfied, he could then make an order for the destruction of the eggs. The magistrate was not an egg tester, and there was not one word in the Act that the justice should inspect the article concerning which complaint had been made.

The Chairman of the Bench said that he, for one, would not hold that, on the *ex parte* statement of an inspector a justice should be entitled to order the destruction of a large amount of private property.

The case was dismissed, without prejudice, but no costs were allowed to the defendant.

The Council gave notice for a case to be stated.

METALLIC IRON IN TEA.

ON October 5th an itinerant tea dealer was summoned at Southend for selling, by the hands of a servant, tea which was not of the substance, nature and quality demanded.

The Town Clerk said that the defendant had three vans from which groceries were sold in different parts of the town. As the result of complaints about the tea, samples were taken at the defendant's yard, and these, on analysis, gave the following results:—The first half-pound packet contained 2·7 grains of iron filings per oz., or 0·62 per cent.; the second sample contained 6·2 grains per oz. (including a piece of wire), or 1·42 per cent.; and the third sample contained 3·8 grains per oz., or 0·88 per cent.

Mr. Leo Taylor, F.I.C., giving evidence in support of his certificate, explained how the iron could get into the tea from "sweepings," and demonstrated its presence in a sample of the tea by means of a magnet.

In cross-examination the witness agreed that H.M. Customs examined, and occasionally rejected, tea containing iron filings. He did not know the number of chests examined by the Customs per week, but the system of the Customs made it unnecessary to examine every chest of tea. He agreed that the amount of metal in the tea was consistent with its being derived from "sweepings." While it was true that large firms used "sweepings" for blending purposes, they cleaned the tea by passing a magnet through it.

The defendant said that he did not dispute the analyses, but he had not put the metallic substance into the tea. He had bought the tea in Mincing Lane, and samples of all teas bought had been passed by the laboratory of H.M. Customs. He pointed out that even the sample of ordinary cheap tea produced by the Public Analyst for comparison had revealed iron when the magnet was drawn through it. If the Bench convicted, it would mean that there would have to be an analyst in every blender's warehouse. The case was one for the Board of Customs and Excise, not for the health authority.

The Bench fined the defendant £10 in each case, with £3 3s. costs. Notice of appeal was given.

EXCESS WATER IN BUTTER: A LEGAL DEFENCE.

A TRADESMAN was summoned at Roscrea for having, on July 19, sold butter which was certified by the Public Analyst to contain 24·91 per cent. of water.

For the defence it was contended that the excess of water was due to the very hot weather at the time. The Food and Drugs Act stated that an offence should not be deemed to be committed where the food and drugs were unavoidably mixed with some extraneous matter in the process of collection or preparation. If the weather was particularly warm, it was impossible to separate all the water from the butter; the more the butter was mixed, the more it was converted into a soft mass.

The defendant's wife said that she had sold this butter as she had received it. Her experience was that it was impossible to extract the water from butter in very hot weather.

A fine of 10s., with 10s. costs, was imposed.

ARSENICAL APPLES.*

ON March 19, 1926, the U. S. Attorney for the Southern District of New York, acting upon a report by the Secretary of Agriculture, applied in the U.S.A. District Court for the seizure and condemnation of 76 boxes of apples, remaining unsold in the original unbroken boxes at New York, alleging that the article had been shipped from the State of Virginia into the State of New York, and charging adulteration in violation of the Food and Drugs Act, for the reason that it contained an added poisonous ingredient, namely, arsenic, which might have rendered it injurious to health.

On April 13, 1926, a fruit company of New York having admitted the allegations, and having consented to the entry of a decree, judgment of condemnation and forfeiture was entered, and it was ordered by the Court that the product be released to the said claimant on payment of the cost of the proceedings and the execution of a bond of $200, conditioned in part that each apple be washed or wiped, and that it not be sold or disposed of until inspected by a representative of the U.S.A. Dept. of Agriculture and satisfactory elimination of the arsenic shown.

On March 17, 1926, the U.S. Attorney for the Eastern District of Pennsylvania, acting on a report from the Secretary of Agriculture, applied for the seizure and condemnation of 84 boxes of apples sent to Philadelphia from the same consignor in Virginia as the article in No. 14213 (*supra*), alleging adulteration with arsenic.

On April 14, 1926, no claimant having appeared for the property, judgment of condemnation and forfeiture was entered, and it was ordered by the Court that the product be destroyed by the U.S. Marshal.

* U.S.A. Dept. Agriculture, Bureau of Chemistry, Service and Regulatory Announcements, August, 1926. Nos. 14213 and 14214.

Ministry of Health.

SALE OF FOOD AND DRUGS ACT.

EXTRACTS FROM THE ANNUAL REPORT OF THE MINISTRY OF HEALTH FOR 1925–1926, AND ABSTRACT OF REPORTS OF PUBLIC ANALYSTS FOR THE YEAR 1925.*

A TOTAL of 7714 samples (6·5 per cent.), out of 118,930 submitted for analysis during 1925 by Local Health Authorities and private persons, were reported as adulterated or not up to standard.

MILK.—Of the 5163 samples reported against, 131 (8·3 per cent.) were on account of contamination by dirt, 60 contained colouring matter, and 21 preservatives.

BUTTER AND MARGARINE.—Of 11,201 samples of butter, 168 were adulterated, 81 containing excess of water and the rest consisting wholly or chiefly of margarine. Of the 25 samples of margarine (of 3409) reported against, 14 had excess of water, 5 of preservative, 3 contained over 10 per cent. of butter fat, and 3 contained mineral oil.

CHEESE.—The 4·4 per cent. of cheese samples condemned were reported against chiefly on account of deficiency of fat. The fact that cream cheese should contain 70 per cent. of fat was not disputed in a prosecution case.

LARD AND OTHER FATS.—Eight out of 2918 lard samples include cases of adulteration with vegetable oils and fats. The majority of 15 samples of dripping contained excess of water or free fatty acids. Samples of shredded suet were reported against for containing undeclared flour.

Apple continued to be the chief adulterant in 116 samples of *jam* (of 1453 examined) and glass, glaze, enamel, or siliceous particles were present in 88 of these samples. Ten samples of *self-raising flour* contained persulphate, and 1 excess of arsenic. Less misleading labels were found in use for *custard*. Foreign starch and fats were found in samples of *chocolate*; several samples of *sweets* contained either French chalk or sulphur dioxide; quartz was present in a consignment of 9000 *chocolate Easter eggs* (*cf.* ANALYST, 1925, **50**, 238); iron oxide was present in a sample of *anchovy paste*; 4 of 725 samples of tea contained mineral matter, one iron filings and pieces of wire and nails (*cf.* ANALYST, 1925, **50**, 553). One sample of *whiskey* was more than 48 degrees under proof; 9 samples of *beer*, out of 387, contained lead, boric acid or excess of salt; a heavy fine was imposed for a *non-alcoholic wine* which was found to be a chemically preserved and flavoured cordial with a trace of quinine; 3 samples of *sugar* contained, respectively, coal tar dye, sawdust and ground rice.

DRUGS.—Of 5175 samples of 156 different kinds of drugs, 277 (5·4 per cent.) were adulterated or not up to standard. *Sweet spirits of nitre* is liable to deteriorate if improperly stored, and 25 per cent. of the 87 samples examined were not up to the B.P. standard. A proprietary preparation declared to contain 30 per cent. of fresh Norwegian *cod liver oil* contained oil apparently hardened, as was also the case with an expensive preparation of cod liver oil and malt declared to contain all the virtues of the original oil without objectionable smell or stickiness. The medicinal value of these products was held to be affected by reduction of vitamin *A* content, and the altering of the nature of the material was held to demand a proper declaration. A sample of *turpentine* consisted of petroleum derivatives, and one of *sal volatile* was 10·1 per cent. deficient in alcohol and contained 2·5 per cent. of chloroform. D. G. H.

* Obtainable at Adastral House, Kingsway, W.C.2. Price 1s. 6d. net.

IMPORTED MILK.

STATUTORY RULES AND ORDERS, 1926, No. 820.

PUBLIC HEALTH, ENGLAND.

THE PUBLIC HEALTH (IMPORTED MILK) REGULATIONS, 1926, DATED JULY 6, 1926, MADE BY THE MINISTER OF HEALTH.*

68,577.

The Minister of Health, in the exercise of the powers conferred upon him by the Public Health Act, 1875, the Public Health (London) Act, 1891, the Public Health Act, 1896, the Public Health (Regulations as to Food) Act, 1907, and Section 8 of the Milk and Dairies Amendment Act, 1922, and of every other power enabling him in that behalf, hereby makes the following Regulations, that is to say:—

1. These Regulations may be cited as the Public Health (Imported Milk) Regulations, 1926, and shall come into operation on the 1st day of January, 1927.

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

"The Minister" means the Minister of Health.

"Sanitary Authority" means a Port Sanitary Authority, and the Council of a Borough or Urban or Rural District which includes or abuts on any part of a Customs port which part is not within the jurisdiction of a Port Sanitary Authority.

"District" means the District of a Sanitary Authority, and in the case of a Sanitary Authority other than a Port Sanitary Authority, includes the waters of any Customs port abutting on any part of their district so far as such waters are not within the district of a Port Sanitary Authority.

"Milk" means milk (including skimmed milk and separated milk, but not including condensed or dried milk) which is intended for sale for human consumption or for use in the manufacture of products for human consumption.

"British Islands" means Great Britain and Ireland, the Channel Islands, and the Isle of Man.

"Imported Milk" means milk imported into England or Wales from any place situated outside the British Islands.

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

3.—(1) Every Sanitary Authority shall enforce and execute these Regulations and shall keep a Register of persons to whom milk imported into their district may be consigned.

(2) Any Officer of the Sanitary Authority, duly authorised in that behalf, may take a sample of any milk imported into the district.

4. No person shall receive any milk consigned to him from any place outside the British Islands unless he is registered under these Regulations by the Sanitary Authority into whose district the milk is imported.

5. All imported milk shall be in such condition that, on a sample being taken within the district of a Sanitary Authority, the milk shall be found to contain not more than 100,000 bacteria per cubic centimetre and to be free from tubercle bacilli.

6.—(1) If the Sanitary Authority are satisfied that any milk imported into their district does not comply with the provisions of these Regulations, they may serve upon the person to whom the milk was consigned a notice to appear before them not less than seven days after the date of the notice, to show cause why they should not, for reasons to be specified in the notice, remove him from the register, either absolutely or in respect of any specified source of supply, and if he fails to show cause to their satisfaction accordingly they may remove him from the register.

* H.M. Stationery Office, 1926. Price 1d. net.

(2) Any person aggrieved by any such decision of the Sanitary Authority as aforesaid may, within twenty-one days, appeal to a Court of Summary Jurisdiction, and that Court may require the Sanitary Authority not to remove him from the register.

(3) The Sanitary Authority, or such person as aforesaid, may appeal from the decision of the Court of Summary Jurisdiction to the next practicable Court of Quarter Sessions, and that Court may confirm, vary or reverse the Order of the Court of Summary Jurisdiction.

(4) The decision of a Sanitary Authority to remove any person from the register shall not have effect until the expiration of the time for appeal to a Court of Summary Jurisdiction, nor if any such appeal is brought until the expiration of seven days after the determination thereof, nor if notice of appeal to Quarter Sessions is given within such seven days until such appeal is finally determined unless such appeal ceases to be prosecuted.

(5) Where, in pursuance of the foregoing provisions of this Article, a person is removed from the register of a Sanitary Authority, the Sanitary Authority shall report the facts to the Minister, and if the Minister on consideration of such facts is of opinion that that person should be removed from the register of any other Sanitary Authority or should not be included in such register either absolutely or in respect of any specified source of supply he may direct such Sanitary Authority so to remove such person from their register or to refuse so to register him as the case may be and such Sanitary authority shall forthwith comply with the Minister's direction.

7. A person shall, if so required, give to any officer of a Sanitary Authority 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 he may reasonably require for the purposes of these Regulations.

Given under the Official Seal of the Minister of Health this Sixth day of July, in the year One thousand nine hundred and twenty-six.

(L.S.) R. B. CROSS,
Assistant Secretary, Ministry of Health.

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, as amended by the Milk and Dairies (Amendment) Act, 1922.

MILK AND DAIRIES, ENGLAND.

STATUTORY RULES AND ORDERS, 1926, No. 821.

THE MILK AND DAIRIES ORDER, 1926, DATED JULY 6, 1926, MADE UNDER THE MILK AND DAIRIES (CONSOLIDATION) ACT, 1915 (5 & 6 GEO. 5. C. 66).*

(68,578.)

PART I.—SHORT TITLE, OPERATION, INTERPRETATION, ETC.

1. This order may be cited as the Milk and Dairies Order, 1926, and shall come into operation on the 1st day of October, 1926:

PART II.—REVOCATION OF ORDERS AND REGULATIONS.

PART III.—REGISTRATION AND NOTICES.

PART IV.—HEALTH AND INSPECTION OF CATTLE.

PART V.—GENERAL PROVISIONS FOR SECURING THE CLEANLINESS OF DAIRIES, ETC., AND FOR PROTECTING MILK AGAINST INFECTION AND CONTAMINATION.

* H.M. Stationery Office, 1926. Price 3d. net.

PART VI.—SPECIAL PROVISIONS APPLICABLE TO COWKEEPERS.

PART VII.—SPECIAL PROVISIONS APPLICABLE TO BUILDINGS USED FOR THE SALE, &C., OF MILK.

PART VIII.—CONVEYANCE AND DISTRIBUTION OF MILK, CHURNS, ETC.

Note.—The Milk and Dairies (Consolidation) Act, 1915, provides by sub-section (3) of section 1 that if any person is guilty of a contravention of, or non-compliance with the provisions of any Milk and Dairies Order, he shall be guilty of an offence against the Act.

Sub-section (1) of section 18 of that Act provides that if any person commits an offence against the Act he shall be liable on summary conviction to a fine not exceeding in the case of a first offence five pounds and in the case of a second or subsequent offence fifty pounds, and if the offence is a continuing offence to a further fine not exceeding forty shillings for each day during which the offence continues.

PRESERVATIVES IN FOOD.

DRAFT RULES AND ORDERS, 1926.

PUBLIC HEALTH, ENGLAND.

DRAFT, DATED SEPTEMBER 21, 1926, OF THE PUBLIC HEALTH (PRESERVATIVES, &C., IN FOOD) AMENDMENT REGULATIONS, 1926, PROPOSED TO BE MADE BY THE MINISTER OF HEALTH.*

(71,203.)

The Minister of Health, in the exercise of the powers conferred upon him by the Public Health Act, 1875, the Public Health (London) Act, 1891, the Public Health Act, 1896, the Public Health (Regulations as to Food) Act, 1907, and the Butter and Margarine Act, 1907, 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:—

1. These Regulations may be cited as the Public Health (Preservatives, &c., in Food) Amendment Regulations, 1926.

2. The Public Health (Preservatives, &c., in Food) Regulations, 1925, shall be amended as follows:—

(1) For the proviso to Article 1 there shall be substituted the following proviso,—

"Provided that—

(i) the Regulations shall come into operation on the 1st day of July, 1927, so far as they relate to bacon, ham and egg yolk, and 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, and the Public Health (Milk and Cream) Regulations, 1912, Amendment Order, 1917, 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 margarine, preserved bacon, preserved ham or preserved butter, they shall come into operation on the 1st day of July, 1927, in cases where the preservative has been so introduced by the use of preserved margarine, on the 1st day of January, 1928, in cases where it has been so introduced by the use of preserved bacon or preserved ham, and on the 1st day of July, 1928, in cases where it has been so introduced by the use of preserved butter."

(2) In the definition of "preservative" contained in Article (2) (1) the word "glycerin" shall be inserted after the word "vinegar."

* H.M. Stationery Office, 1926. Price 1d. net.

(3) In Part I of the First Schedule for the items numbered 2, 6 and 7 there shall be substituted the following items,—

Food.	Preservative.	Parts per Million.
2. Fruit and fruit pulp (not dried) for conversion into jam or crystallised or glacé fruit as defined in items 6 and 7:		
(*a*) Cherries	Sulphur Dioxide	3,000.
(*b*) Strawberries and Raspberries	,, ,,	2,000
(*c*) Other fruit	,, ,,	1,500
6. Jam (including marmalade and fruit jelly prepared in the way in which jam is prepared)	,, ,,	40
7. Crystallised and glacé fruit (including candied peel)	,, ,,	100

3. Copies of the Public Health (Preservatives, &c., in Food) Regulations, 1925, printed under the authority of His Majesty's Stationery Office, may be printed with any additions, omissions or substitutions directed to be made by these or any other amending regulations, but with a footnote in each instance referring to such amending regulations; and the principal regulations so printed may be cited as the Public Health (Preservatives, &c., in Food) Regulations.

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

APPOINTMENT.

The Minister of Health has appointed Mr. J. N. Beckett of the Food Department of the Ministry to be in Charge of the Preservatives Regulations when they come into force on January 1, 1927.

United States Department of Agriculture.

Office of the Secretary, Washington, D. C.

FOOD INSPECTION DECISIONS

ISSUED AUGUST, 1926.

The following revised and amended definitions and standards were adopted by the Joint Committee on Definitions and Standards, composed of representatives of the United States Department of Agriculture, the Association of American Dairy, Food and Drug Officials, and the Association of Official Agricultural Chemists, at its meeting, January 18 to 29, 1926.

No. 198. WINE VINEGAR, GRAPE VINEGAR AND MALT VINEGAR.

2. WINE VINEGAR, GRAPE VINEGAR, is the product made by the alcoholic and subsequent acetous fermentations of the juice of grapes, and contains, in one hundred (100) cubic centimeters (20° C.), not less than four (4) grms. of acetic acid.

3. MALT VINEGAR is the product made by the alcoholic and subsequent acetous fermentations, without distillation, of an infusion of barley malt or cereals whose starch has been converted by malt, and contains, in one hundred (100) cubic centimeters (20° C.), not less than four (4) grms. of acetic acid.

No. 199. GLUTEN FLOUR, SELF-RAISING, "DIABETIC" FOOD, AND CANNED PEA GRADES.

OFFICE OF THE SECRETARY, CIRCULAR 136, PAGE 7.

7. GLUTEN FLOUR, SELF-RAISING, is a gluten flour containing not more than ten per cent. (10 per cent.) of moisture, and leavening agents with or without salt.

8. "DIABETIC" FOOD.—Although most foods may be suitable under certain conditions for the use of persons suffering from diabetes, the term "diabetic" as applied to food indicates a considerable lessening of the carbohydrates found in ordinary products of the same class, and this belief is fostered by many manufacturers on their labels and in their advertising literature.

A "diabetic" food contains not more than half as much glycogenic carbohydrates as the normal food of the same class. Any statement on the label which gives the impression that any single food in unlimited quantity is suitable for the diabetic patient is false and misleading.

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6. CANNED PEA GRADES.—*Fancy peas* are young, succulent peas of fairly uniform size and colour, unless declared to be ungraded for size, with reasonably clear liquor, and free from flavour defects due to imperfect processing.

Standard peas are less succulent peas than the "fancy" grade, but green and of mellow consistence, of uniform size and colour, unless declared to be ungraded for size, with reasonably clear liquor, though not necessarily free from sediment, and reasonably free from flavour defects due to imperfect processing.

Substandard peas are peas that are overmature, though not fully ripened, or that lack in other respects the qualifications for the standard grade.

The foregoing definitions and standards No. 6 are hereby revoked.

No. 200. MILK AND ITS PRODUCTS, INCLUDING PASTEURISED MILK, EVAPORATED MILK, SWEETENED CONDENSED MILK, EVAPORATED SKIMMED MILK, SWEETENED CONDENSED SKIMMED MILK, DRIED MILK, AND DRIED SKIMMED MILK.

The following revised and amended definitions and standards for milk and its products, (*a*) milks, were adopted by the Joint Committee on Definitions and Standards, composed of representatives of the United States Department of Agriculture, the Association of American Dairy, Food and Drug Officials, and the Association of Official Agricultural Chemists, at its meeting, January 18 to 29, 1926.

1. MILK is the whole, fresh, clean lacteal secretion obtained by the complete milking of one or more healthy cows, properly fed and kept, excluding that obtained within 15 days before and 5 days after calving, or such longer period as may be necessary to render the milk practically colostrum-free.

2. PASTEURISED MILK is milk that has been subjected to a temperature not lower than 145° F. for not less than 30 minutes, after which it is promptly cooled to 50° F. or lower.

3. HOMOGENISED MILK is milk that has been mechanically treated in such a manner as to alter its physical properties with particular reference to the condition and appearance of the fat globules.

4. SKIMMED MILK is milk from which substantially all of the milk fat has been removed.

5. BUTTERMILK is the product that remains when fat is removed from milk or cream, sweet or sour, in the process of churning. It contains not less than eight and five-tenths per cent. (8·5 per cent.) of milk solids-not-fat.

6. GOAT'S MILK, EWE'S MILK, ETC., are the fresh, clean lacteal secretions, free from colostrum, obtained by the complete milking of healthy animals other than cows, properly fed and kept, and conform in name to the species of animal from which they are obtained.

7. EVAPORATED MILK is the product resulting from the evaporation of a considerable portion of the water from milk, or from milk with adjustment, if necessary, of the ratio of fat to non-fat solids by the addition or by the abstraction of cream. It contains not less than seven and eight-tenths per cent. (7·8 per cent.) of milk fat, nor less than twenty-five and five-tenths per cent. (25·5 per cent.) of total milk solids; provided, however, that the sum of the percentages of milk fat and total milk solids be not less than thirty-three and seven-tenths (33·7).

8. SWEETENED CONDENSED MILK is the product resulting from the evaporation of a considerable portion of the water from the whole, fresh, clean, lacteal secretion obtained by the complete milking of one or more healthy cows, properly fed and kept, excluding that obtained within fifteen days before and ten days after calving, to which sugar (sucrose) has been added. It contains not less than twenty-eight per cent. (28 per cent.) of total milk solids, and not less than eight per cent. (8 per cent.) of milk fat.

9. EVAPORATED SKIMMED MILK is the product resulting from the evaporation of a considerable portion of the water from skimmed milk, and contains not less than twenty per cent. (20 per cent.) of milk solids.

10. SWEETENED CONDENSED SKIMMED MILK is the product resulting from the evaporation of a considerable portion of the water from skimmed milk to which sugar (sucrose) has been added. It contains not less than twenty-four per cent. (24 per cent.) of milk solids.

11. DRIED MILK is the product resulting from the removal of water from milk, and contains not less than twenty-six per cent. (26 per cent.) of milk fat, and not more than five per cent. (5 per cent.) of moisture.

12. DRIED SKIMMED MILK is the product resulting from the removal of water from skimmed milk, and contains not more than five per cent. (5 per cent.) of moisture.

No. 201. GLUCOSE, MIXING GLUCOSE, CONFECTIONER'S GLUCOSE.

GLUCOSE, MIXING GLUCOSE, CONFECTIONER'S GLUCOSE, is a thick, syrupy, colourless product made by incompletely hydrolysing starch, or a starch-containing substance, and decolorising and evaporating the product. It contains on a basis of forty-one (41) degrees Baumé not more than one per cent. (1 per cent.) of ash, consisting chiefly of chlorides and sulphates.

The foregoing definitions and standards are adopted as a guide for the officials of this department in the enforcement of the Federal Food and Drugs Act.

W. M. JARDINE,
Secretary of Agriculture.

WASHINGTON, D.C.,
July 3, 1926.

ABSTRACTS OF PAPERS PUBLISHED IN OTHER JOURNALS.

Food and Drugs Analysis.

Determination of Sugars in Honey. F. Lucius. (*Z. Unters. Lebensm.*, 1926, **51**, 351–357.)—The dextrin present in honey may be removed by treatment with alcohol and ether, and the sugars in the extract may then be determined by the usual methods. The procedure recommended is as follows:—A solution of 10 grms. of the honey in 10 grms. of water is transferred to a weighed 500 c.c. Erlenmeyer flask by means of 200 c.c. of 96 per cent. alcohol. The solution is treated with 100 c.c. of ether in a thin stream, being steadily rotated meanwhile in order to prevent pronounced balling of the precipitate. The flask is then stoppered and left for 24 hours, the clear, supernatant liquid then filtered into a 500 c.c. beaker, and the flask rinsed out with three 25 c.c. quantities of alcohol-ether (2:1). The dextrinous residue is weighed after being dried for two hours at 100° C. The alcohol and ether are carefully evaporated from the solution, the residual sugars dissolved in hot water, and the solution made up to 100 c.c. at 17·5° C. Fifty c.c. of this solution are inverted, made up to 100 c.c., cleared with a little kieselguhr, and its optical rotation determined in a 200 mm. tube at 17·5° C. The laevulose in the remaining 50 c.c. of the sugar solution is destroyed by heating the liquid with acid (ANALYST, 1923, **48**, 607), and the rotation

of the dextrose determined. In a 200 mm. tube a rotation of $+1°$ corresponds with 0·95 grm. of dextrose, and $-1°$ with 0·54 grm. of laevulose. This method gives accurate figures for the percentage of laevulose, the various small errors compensating one another. The numbers for the dextrose are not so exact, possibly owing to the presence of condensation products. Probably determination of the dextrose by means of iodine, after treatment with ether, is preferable to the polarimetric method. T. H. P.

The Determination of Fructose, Sucrose and Inulin. W. R. Campbell and M. I. Hanna. (*J. Biol. Chem.*, 1926, **69**, 703–711.)—Methods for the determination of fructose, sucrose and inulin in pure solution, and in the presence of glucose, lactose and maltose, and in blood filtrates have been described, based on the method of Campbell (*J. Biol. Chem.*, 1926, **67**, 59) for the determination of dihydroxyacetone in blood. These methods consist in the direct reduction of molybdenum in phosphoric acid solution, and subsequent re-oxidation by means of standard potassium permanganate solution. The paper deals chiefly with the establishment of the conditions most suitable for the determination of the carbohydrates named. Satisfactory results have not yet been obtained with urine, since the reducing action is not a specific one for carbohydrates. The effect of boiling on the reduction was considered and the reaction time curve for fructose and sucrose is given. It is found that slight variations in the temperature of the water bath have a marked effect. P. H. P.

Pectic Acids. E. K. Nelson. (*J. Amer. Chem. Soc.*, 1926, **48**, 2412.)—This paper tends to establish the identity of the pectic acid of Wichmann and Chernoff (obtained by the alkaline hydrolysis of fruit products) with the digalacturonic acid of Ehrlich and Sommerfeld, obtained by the acid hydrolysis of the pectic substances in sugar-beet. One hundred grms. of citrus pectin were hydrolysed with dilute sodium hydroxide solution for 15 minutes at room temperature, acidified with hydrochloric acid, and boiled for 5 minutes according to Wichmann and Chernoff's procedure. After solution in dilute sodium hydroxide the precipitate was re-precipitated with excess of acid, filtered off, washed free from acid with water, and finally with alcohol and ether, and dried in a vacuum oven. The yield was 39 grms. The identity of this substance was determined by determining its combining weight, the specific rotation of a solution of its sodium salt, its ultimate analysis, and the m.pt. of its cinchonine salt. The following table shows the close agreement between the figures found by the author and those given by Ehrlich.

	Found by author.	Found by Ehrlich.	Calculated for $C_{10}H_{14}O_8(COOH)_2 + H_2O$.
Sodium hydroxide (0·1 *N*) to neutralise 1 grm., c.c.	52·9	54·0	54
$[\alpha]_D$	+289·5°	+272° to +285°	
Hydrogen, per cent. ..	4·99	—	4·86
Carbon, per cent. ..	39·35	—	38·92
M.pt. of cinchonine salt..	159–160° C.	158° C.	—

R. F. I.

Determination of Acidity of Highly Coloured Fruit-type Products. C. H. Badger and J. W. Sale. (*J. Assoc. Off. Agric. Chem.*, 1926, **9**, 342–346.)—The sample, containing 140–160 mgrms. of acid (previously ascertained and adjusted) and not more than 40 mgrms. of sugar, is placed in a flask marked at 100 and 200 c.c., diluted to 200 c.c., a piece of "nun's veiling" of 15 sq. in. added, boiled until the liquid level falls to the 100 c.c. mark, cooled, and the liquid poured off and titrated with 0·1 *N* sodium hydroxide solution, 6 to 10 drops of 0·5 per cent. phenolphthalein solution being used as indicator. The cloth in the flask is washed with two successive portions of 150 c.c. of boiled distilled water, the material being left to soak 4 and 3 minutes respectively, and each portion titrated. The permitted colours that interfere most seriously with the use of phenolphthalein as indicator (red shades) dye readily, and usually leave the liquid practically free from the interfering colour. D. G. H.

Rapid Determination of Alcohol in Distilled Spirits and of Colour in Whiskey. J. F. Williams. (*Ind. Eng. Chem.*, 1926, **18**, 841–843.)—Ten c.c. of the spirit are shaken at 20° C. with 10 c.c. of a mixture of amyl alcohol, 70 c.c., toluene, 28 c.c., and 50 per cent. aqueous tartaric acid solution, 2 c.c. The volume of the lower (aqueous) layer after the mixture has separated is an approximate measure of the amount of water (and alcohol) in the sample. The subjoined table is given showing the exact percentages of alcohol corresponding with varying volumes of the aqueous layer. Added caramel in the spirit colours the aqueous layer.

CONVERSION OF READINGS TO PERCENTAGES OF ALCOHOL.

Height of lower layer, ml. ..	10·20	9·90	9·60	9·30	8·90	8·50	8·05	7·40	6·80	6·70	6·60
Alcohol, per cent. by vol. ..	0	5	10	15	20	25	30	35	40	41	42
Height of lower layer, ml. ..	6·50	6·35	6·15	5·90	5·70	5·45	5·25	5·10	4·85	4·65	4·40
Alcohol, per cent. by vol. ..	43	44	45	46	47	48	48	50	51	52	53
Height of lower layer, ml. ..	4·15	3·90	3·60	3·30	3·00	2·65	2·30	1·95	1·50	1·05	0·60
Alcohol, per cent. by vol. ..	54	55	56	57	58	59	60	61	62	63	64

W. P. S.

Chemical Composition of Rice Oil. G. S. Jamieson. (*J. Oil and Fat Ind.*, 1926, **111**, 256.)—Rice oil, extracted by ethyl ether from rice-bran had the following characteristics:—n_D^{25}, 1·4690; acid value (2 weeks after extraction), 73·7; saponification value, 185·3; iodine value (Hanus), 99·9; unsaponifiable matter, 4·64 per cent.; saturated acids (corrected), 14·7; unsaturated acids (corrected), 74·3 per cent.; Reichert-Meissl value, 0·3; Polenske value, 0·3. About 25 per cent. of the unsaponifiable matter was found to consist of sterols with m.pts. ranging from 137° to 145° C. In order to bring about complete crystallisation (in the digitonin method of separation) it was found necessary to rub the sides of the flask with a rod, for otherwise no precipitate formed from a dilute alcoholic solution of the isolated sterols and a 1 per cent. solution of digitonin. A small quantity of (apparently) melissyl alcohol was also obtained from the unsaponifiable matter. A quantity of the unsaturated acids was prepared

by the lead salt and ether method and esterified with methyl alcohol, and the mixture fractionally distilled. The composition of the fatty acids of this rice oil was thus deduced as :—Oleic, 41 ; linolic, 36·7 ; myristic, 0·3 ; palmitic, 12·3 ; stearic, 1·8 ; arachidic, 0·5 ; and lignoceric, 0·4 per cent. (*cf.* Smetham, ANALYST, 1893, **18**, 191.) D. G. H.

Detection of added Pepper Shells in Pepper. E. R. Smith, S. Alfend and L. C. Mitchell. (*J. Assoc. Off. Agric. Chem.*, 1926, **9**, 333–342.)—The addition of small quantities (10 per cent. or even less if the variety of pepper is known) of pepper shell may be detected by determining crude fibre, *d*-glucose and magnesium oxide, for whole pepper contains about half as much magnesium and crude fibre and more than twice as much *d*-glucose as does pepper shell. Siftings added to pepper, instead of shells, result in the pepper showing high total and acid-insoluble ash without abnormality in the other significant values. Maximum minimum and average figures are given in the detailed analyses of the peppers examined.

AVERAGES.

Origin.	No. of samples.	Crude fibre.	*d*-Glucose.	MgO.	MgO × CF.	$\frac{MgO \times 1000}{d\text{-glucose.}}$
Lampong	18	13·9	52·5	0·42	5·8	8·1
Allepi	9	13·0	56·1	0·41	5·3	7·3
Tellicherry	5	14·4	57·5	0·40	5·8	7·0
Singapore	2	15·6	55·1	0·43	6·7	7·8
White and decorticated	4	14·1	77·9	0·61	0·7	2·1
Shells	4	31·6	21·2	0·80	25·3	37·8
		24·4	29·3	0·64	15·6	21·9
		25·3	29·7	0·64	16·2	21·5
		30·0	21·1	0·79	23·7	37·4
Siftings	3	18·3	12·8	—	—	—
		20·8	14·8	—	—	—
..		24·6	22·5	0·61	15·0	27·1

D. G. H.

Determination of the Essential Oil in Spice. C. Griebel. (*Z. Unters. Lebensm.*, 1926, **51**, 321–324.)—By the following procedure the essential oil in a spice may be determined in about three hours. Ten grms. of the ground spice (5 grms. in the case of cloves) in a flask of about 1 litre capacity, connected by a doubly-bent tube with a vertical condenser, are covered with 300 c.c. of water and distilled in presence of a fragment of porous tile into an Erlenmeyer flask or a separating funnel with marks at 150 c.c. and 200 c.c. ; the flask is heated on a gauze with a powerful Bunsen burner. When 150 c.c. of distillate have collected, the flame is removed, and, when boiling ceases, the liquid is swirled so as to wash down any powder adhering to the glass. Distillation is continued until a further 50 c.c. of distillate collects, any turbidity due to separation of essential oil on the cooling tube being removed by brief stoppage of the condenser water ; the condenser tube should not touch the liquid. The total distillate, together with

60 grms. of salt, is shaken with three successive 20 c.c. quantities of pentane, which are then introduced into a weighed wide-mouthed Erlenmeyer flask of about 100 c.c. capacity and evaporated on a water-bath at a moderate temperature; the last traces of the solvent are expelled by a gentle stream of dry air. The weight of the flask after remaining 30 minutes in a desiccator should not diminish after a further stay of 15 minutes. Kahlbaum's "Pentan aus Petroleum," but not "Pentan für Photometrie," is suitable for the above extraction, but the volatility should be tested. T. H. P.

Official Titles of the Silver Proteins. J. W. E. Harrison. (*Amer. J. Pharm.*, 1926, **98**, 480–481.)—In the new U.S.A. Pharmacopoeia *Argentum-Proteinum Forte* (Silver Protein Strong, Strong Protargin) is defined as a compound containing not less than 7·5, and not more than 8·5 per cent. of silver. *Argentum-Proteinum Mite* (Mild Silver-Protein, Mild Protargin) is defined as silver rendered colloidal by the presence of, or combination with, protein. It contains not less than 19 per cent., and not more than 25 per cent. of silver. These terms have been incorrectly interpreted by some, owing to the fact that the *mild* compound contains the greater proportion of silver. The adjectives "strong" and "mild" refer to the physiological action, the ionisable content of silver being much greater in the "strong" proteins (7·5 to 8·5 per cent.) than in the "mild" proteins (18 to 25 per cent.). The American Medical Association has grouped the various commercial preparations of silver proteins into the following 4 classes:—Group I—Protargin Strong or Protargol Type: Protargol, Proganol, Protargentum-Squibb. Group II—Protargin Mild or Argyrol Type: Argyn, Argyrol, Cargentos, Silvol, Solargentum-Squibb, Vargol. Group III—Collargol Type: Collargol. Group IV—Electric Type: None on the market.

Biochemical, Bacteriological, etc.

Nitrates in Animal and Vegetable Tissues. E. Kohn-Abrest and S. Kawakibi. (*Compt. rend.*, 1926, **183**, 522–524.)—Nitrates may be determined in solid bodies by macerating 25 grms. of material in 100 c.c. of water, and, after an hour, drying the residue, washing, and treating the united liquids with 1 per cent. lead subacetate solution. After boiling, filtering, washing, eliminating excess of lead with sodium carbonate, filtering, acidifying with acetic acid and concentrating under reduced pressure at about 70° C. to a syrupy consistence (the flask being cooled in water), 8 c.c. of sulphuric acid (sp. gr., 1·84) are added and left in contact with the cooled liquid for 30 minutes. The mixture is then introduced into a Kohn-Abrest tube, previously filled with mercury and placed over a trough of mercury, and well shaken for 10 minutes. The liberated gas is collected and measured in the upper part of the tube which is graduated in twentieths of a c.c., and identified. For liquids 20–100 c.c. are treated directly with the lead acetate solution. Nitrates were not found under normal conditions in the chief vegetable foods examined, and this in spite of the fact that nitrates are used as fertilisers,

or in butchers' meat, but were present in cows' milk (80 mgrms. as N_2O_5 per litre) and in human milk (145 to 190 mgrms.). In cows' milk, however, they were not invariably present. Nitrates were absent from the human organs examined, but were present in urine in proportions of the order found in human milk. Nitrates were found to be accidentally present in certain suspected forage beets.

D. G. H.

A Differentiation between the Water-Soluble Growth-Promoting and Anti-Neuritic Substances. S. M. Hauge and C. W. Carrick. (*J. Biol. Chem.*, 1926, **69**, 403–413.)—Many investigators have concluded that the anti-neuritic and the water-soluble growth-promoting vitamins are identical, and a few have suggested that they are not identical, but until now no conclusive evidence has been presented on the subject. The authors have carried out experiments with dried brewers' yeast and corn on baby chicks. The results show that the yeast used was poor in the anti-neuritic substance, but rich in the water-soluble growth-promoting substance, whilst corn was relatively rich in the anti-neuritic substance, but poor in the growth-promoting substance. There is very definite evidence that the anti-neuritic substance, when supplied in abundance, will not promote rapid growth, and that a diet may be capable of promoting rapid growth without preventing polyneuritis. It is therefore concluded that the anti-neuritic vitamin and the water-soluble growth-promoting vitamin are not identical, although they may occur in the same food. P. H. P.

Preservation of Vitamin *C* in Dried Orange Juice. G. J. Humphrey. (*J. Biol. Chem.*, 1926, **69**, 511–512.)—An experiment was carried out to see whether vitamin *C* in some dried orange juice and sugar mixture, which had been kept under partial vacuum for over 5 years, was still effective in preventing scurvy. Sugar had been added to the juice to make it contain 25 per cent. of solids. It was then dried in the apparatus described by McClendon (*J. Biol. Chem.*, 1921, **47**, 411). Three guinea pigs were placed on a basic diet containing no vitamin *C*. One of them, the control, was fed entirely on this diet. Another guinea pig was given, in addition, 1 c.c. of fresh orange juice daily, and the third guinea pig was given the basic diet plus 0·25 grm. of the dried orange juice and sugar mixture (equivalent to 1 c.c. of orange juice) dissolved in water. The feeding was continued through a period of 32 days, and then the guinea pigs were killed with chloroform and examined by dissection. The control was found to exhibit evidences of scurvy, but the other two were both healthy and normal. Thus the vitamin *C* in the dried orange juice was still effective in preventing scurvy at the end of 5 years.

P. H. P.

Spectroscopic Observations on Cod Liver Oil. II. Absorption Bands of Cholesterol. F. W. Schlutz and M. R. Ziegler. (*J. Biol. Chem.*, 1926, **69**, 415–419).—In a former communication by Schlutz and Morse (*Amer. J. Dis. Child.*, 1925, **30**, 199) the absorption spectrum of cod liver oil was shown to have two shallow absorption bands of about 328 and 279$\mu\mu$ wave-length. A study of the

absorption spectrum of cholesterol showed that the wave-lengths between 294 and 296$\mu\mu$, and between 279 and 294$\mu\mu$, are selectively absorbed by non-irradiated cholesterol, and that beyond 294$\mu\mu$ a great deal of general absorption occurs. Probably it is the selectively absorbed wave-lengths which disappear on irradiation which are effective in activating cholesterol. The two characteristic bands in the absorption spectrum of cholesterol have been studied to learn what factor causes their appearance and disappearance. Pfanstiehl's cholesterol was used for this study, since it was concluded to be identical with cod liver oil cholesterol. Different fractions were taken, and sometimes second crops of crystals were prepared. Many spectrograms of groups of crystals (in ether solution) were examined, and it was found that samples of hydrated cholesterol, which melted at, or near, 148·5° C., showed bands, whereas the others did not. Spectrograms of the mother liquors showed no bands, but only great general absorption. After irradiation, hydrated cholesterol showed increased absorption, but dehydrated cholesterol showed only a slight increase in absorption. Chloroform used in place of ether gave similar results. Spectrograms of hydrated cholesterol are characterised by two absorption bands of about 294 and 279$\mu\mu$ wave-length. Preparations of anhydrous cholesterol showed much greater general absorption than the hydrated form. P. H. P.

Isolation and Crystallisation of the Enzyme Urease. J. B. Sumner. (*J. Biol. Chem.*, 1926, **69**, 435–441.)—A new crystallisable globulin which is believed to be identical with the enzyme urease has been isolated from the jack bean, *Canavalia ensifornis*. The method of preparation of the crystals is described in detail; briefly it is as follows:—Finely powdered, fat-free jack bean meal is extracted with 31·6 per cent. acetone, and the material is filtered by gravity in an ice chest. After standing overnight the filtrate is centrifuged and the precipitate of crystalline urease is stirred with cold 31·6 per cent. acetone and centrifuged again. The crystals are then dissolved in distilled water, and centrifuged free from insoluble and inactive matter that has passed through the filter during filtration. As much as 47 per cent. of the urease extracted from the meal may be present in the crystals. The crystals are sharply crystallised, colourless octahedra, show no double refraction, and are from 4μ to 5μ in diameter. In solution they possess to an extraordinary degree the ability to decompose urea into ammonium carbonate. Their other properties are given. The material is regarded as a globulin, although the crystals dissolve in distilled water, because a precipitate is formed when carbon dioxide is passed into its solution, and this precipitate immediately redissolves upon the addition of a drop of neutral phosphate solution. The author believes that no specific co-enzyme of urease exists, although the literature contains many references to such a co-enzyme. The authors conclude that the octahedral crystals and the enzyme urease are identical for the following reasons, *inter alia*:—(*a*) The fact that the crystals can be seen by the microscope to be practically uncontaminated by any other material; (*b*) the great activity of solutions of the crystals; (*c*) the fact that solvents which do not dissolve the

crystals extract little or no urease, and that to obtain solutions of urease one must dissolve the crystals; and (*d*) the fact that the other crystallisable jack bean globulins, concanavalin A and B, carry with them very little urease when formed from solutions comparatively rich in urease. P. H. P.

Glucose and Fructose Retardation of Invertase Action. J. M. Nelson and R. S. Anderson. (*J. Biol. Chem.*, 1926, **69**, 443–448.)—A brief discussion is given of several recent papers which deal with the influence of glucose and fructose on the rate of hydrolysis of sucrose by invertase. These do not consider the influence of the sucrose concentration on the extent of retardation, but a study of this influence was carried out by Anderson (*Dissertation*, Columbia University, New York, 1925), and a brief account of his work on it is given. The rates of hydrolysis were determined for a series of sucrose solutions which contained 2, 5, 10, and 20 per cent. of sucrose, but which all had the same amount of the same invertase and the same concentration of hydrogen ion. These rates were then compared with the rates of a series of corresponding sucrose solutions which had added amounts of either α- or β-glucose or fructose. In order to reduce the variation in concentration of the hexose, due to muta-rotation, the hydrolyses were run at 0·13° C., and the rates were usually measured in the earlier stages of the hydrolyses. The results are tabulated and also shown graphically. The retardation decreases as the sucrose concentration is increased, and, although the β-glucose retards more than the muta-rotated fructose and that, in turn, more than the β-fructose, yet all these curves are similar in shape. Thus these three hexoses cause retardations which are similar in character. This is not true when α-glucose is the added retardant. At 2 per cent. of sucrose this glucose mutamer retards less than, and at 20 per cent. of sucrose more than, any of the others. Thus the curve is of a different shape, and the retardation of α-glucose is less dependent on the sucrose concentration than is the case for β-glucose or fructose. The way in which the retardation is brought about is also different. Thus, for a comparison of the relative retardations induced by the two modifications of glucose, the concentration of sucrose must be taken into account.

Colorimetric Determination of Tyrosine, Tryptophane and Cystine in Proteins. II. J. M. Looney. (*J. Biol. Chem.*, 1926, **69**, 519–538.)—The limitations of the various methods for the determination of tyrosine and tryptophane are discussed very fully. The errors in the conclusions of Gortner and Holm (*J. Amer. Chem. Soc.*, 1920, **62**, 678), Fürth and others, and Kraus concerning the methods of Folin and Looney (*J. Biol. Chem.*, 1922, **51**, 421 ; ANALYST, 1922, 359) are pointed out, and evidence in support of these methods is given. The author concludes that Gortner and Holm misinterpreted his results " because of lack of understanding of the fundamental principles of colorimetric procedures." The method of Hanke (*J. Biol. Chem.*, 1925, **66**, 475), based on the diazo reaction, which he had previously shown to be unsuitable for the determination of tyrosine in protein-containing mixtures (*J. Biol. Chem.*, 1922, **50**, 262), is shown to be worthless, because tryptophane and cystine are precipitated during the process,

and the presence of small amounts of tryptophane seriously affects the depth of colour. The colour produced by 3 mgrms. of tyrosine alone is more than four times as deep as that produced by 3 mgrms. of tyrosine plus 1 mgrm. of tryptophane. The results of Folin and Looney have been confirmed, except in the case of the tyrosine content of gliadin and edestin and the cystine content of zein. The new figures for these constituents are shown to be more consistent with the values obtained by Folin and Denis (*J. Biol. Chem.*, 1912, **12**, 239) and Jones, Gersdorff and Moeller (*J. Biol. Chem.*, 1924–5, **62**, 183). The values obtained are shown to agree remarkably well with the per cents. calculated from the molecular weights given by Cohn, Hendry and Prentiss (*J. Biol. Chem.*, 1925, **63**, 721.) P. H. P.

Determination of Cystine in Urine. H. B. Lewis and R. H. Wilson. (*J. Biol. Chem.*, 1926, **69**, 125–131.)—A comparison has been made of the colorimetric method of Looney (*J. Biol. Chem.*, 1922, **54**, 171), the gravimetric method of Gaskell (*J. Physiol.*, 1907–8, **36**, 142) and the polarimetric method of Magnus-Levy (*Biochem. Z.*, 1925, **156**, 150) for the determination of cystine in urine. Cystine was added, as the sulphate or the hydrochloride, in known amounts to normal urine or to water. The direct colorimetric procedure was found to be far superior to those which involve precipitation, particularly where small amounts of cystine are concerned. The precipitation methods give results which are 40 to 50 per cent. too low if the amounts of cystine are of the order of magnitude usually present in cystinuric urine. If it is considered desirable to precipitate the cystine for the analysis, it is recommended that the purity of the precipitated cystine be determined by polarimetric (Magnus-Levy) or colorimetric (Looney) methods, since the cystine weighed in Gaskell's gravimetric method was found to be impure. Its purity was checked polarimetrically, colorimetrically and, in some cases, by the gravimetric determination of the sulphur content. In these experiments no superiority of alcohol over acetone as a cystine precipitant was found as maintained by Magnus-Levy. P. H. P.

Anaerobic Spore-Bearing Bacteria in Milk. E. A. Bliss. (*Amer. J. Hyg.*, 1926, **6**, 627–645.)—Forty-three samples of milk from Baltimore were examined for anaerobic spore-bearing bacteria, and 55 strains of anaerobes were isolated from 20 of the samples and subjected to morphological and cultural study. Four distinct species of anaerobes were identified, *viz. Clostridium tertium* (Henry, 1916), of which 31 strains were obtained from 12 samples ; *C. sporogenes* (Metchnikoff, 1908), with 19 strains from 16 samples ; *C. Welchii* (Welch and Nuttall, 1892) in one sample, but its presence could be demonstrated by a special technique i 90 per cent. of the raw and pasteurised milks examined ; and *C. bifermentans* (Tissier and Martelly, 1902), with 3 strains from 2 samples. Sixty per cent. of the strains were saccharolytic, 36·4 per cent. strongly proteolytic, and 3·6 per cent. feebly proteolytic. *C. butyricum* was not isolated from any sample, and it is suggested that this organism is probably not so widely distributed in nature as formerly was thought.

Toxicological and Forensic.

Toxicology of Methyl Alcohol. O. Windhausen. (*Chem. Ztg.*, 1926, **50**, 588.)—The author's experiments have indicated that the fatal dose of methyl alcohol for man is considerably under 120 to 240 grms. In one case in Munster a woman died after drinking six small glasses of a factitious brandy, whilst her husband who had drunk 10 small glasses, followed by milk, which had made him sick, recovered. The " brandy " contained about 20 per cent. (by vol.) of methyl alcohol, so that the fatal dose in this case was 20 to 30 grms. The view of Gadamer (in his text book) and of other toxicologists, *viz.* that the poisonous action of methyl alcohol is to be attributed to acetone, formaldehyde or other impurities, is erroneous ; none of these impurities could be detected in samples submitted for examination. The extraordinarily slow oxidation in the body is characteristic of methyl alcohol, elimination not being complete until after 3 or 4 days. Hence the consumption of small quantities of methyl alcohol on successive days leads to its accumulation in the system, and will cause death. Under analogous conditions ethyl alcohol is distributed through the system much more rapidly, and can undergo oxidation within 20 hours after consumption. Methyl alcohol is stable in the dead organism for a very long time ; thus it could be detected in a body six months after death. The natural occurrence of methyl alcohol in fermented liquors is a factor which has to be taken into consideration in deciding as to the significance of small amounts of methyl alcohol in spirits, and the author finds that it occurs as a normal fermentation product more frequently than is commonly believed. He was unable to detect it, however, in several samples of genuine brandy and rum.

Kolthoff's method of detection (oxidation of the methyl alcohol in phosphoric acid solution and detection of the resulting formaldehyde by means of Schiff's reagent) is a more sensitive test than the method of Denigès (oxidation by means of acid permanganate). Smiedel's method, which is based on the oxidation of the methyl alcohol to formic acid by means of 1 per cent. alcoholic hydrogen peroxide solution in the cold, is not suitable for analytical practice.

In Kolthoff's method (*Pharm. Weekbl.*, 1922, **59**, 1268) the substitution of the phosphoric acid for the usual sulphuric acid causes the oxidation to proceed much more slowly, decolorisation of the permanganate not being complete until after about 15 minutes, as compared with 2 minutes with the equivalent quantity of sulphuric acid.

Organic Analysis.

Rapid Method for Determination of Organic Nitrogen. G. Jaramillo. (*J. Amer. Chem. Soc.*, 1926, **48**, 2453.)—The substance to be analysed is heated in a copper test-tube (17·8 cm. long × 2·5 cm. in diameter) with 1 grm. of sodium hydroxide and 2 grms. of sodium acetate crystals. The test-tube is provided with a cork and delivery-tube for leading the evolved ammonia into a flask containing 25 c.c. of 0·1 *N* sulphuric acid. The mixture is heated, gently at first till the water of crystallisation is expelled, and then more strongly, till white fumes are evolved, this being an indication of formation of methane which drives the last

traces of ammonia out of the tube. The excess of sulphuric acid in the receiver is titrated with 0·1 *N* sodium hydroxide, litmus being used as indicator. A comparison of the results by this method with those obtained by Kjeldahl's method is as follows :

Percentage nitrogen.	Kjeldahl.	Above method.
Wheat flour	2·52	2·59
Mixed fertiliser	2·10	2·15
Blood fertiliser	12·11	12·38
Soil	0·07	0·07
Soil	0·23	0·23

For substances rich in nitrogen, results by this method are 2 per cent. higher than by Kjeldahl's method. Liquids such as milk and beer are evaporated to dryness in a shallow dish lined with tinfoil, which can then be transferred to the copper tube and treated as above. The whole analysis occupies 30 minutes.

R. F. I.

Detection and Determination of Lactic Acid in the presence of other Organic Acids. E. K. Nelson. (*J. Assoc. Off. Agric. Chem.*, 1926, **9**, 331–333.) —A modification of the Kunz and Phelps-Palmer methods is satisfactory for the determination of lactic acid in the presence of malic, tartaric, citric and benzoic acids, and identification of the acid as quinine lactate is recommended. The sample (100 grms.) is diluted with 100 c.c. of warm water, 200 c.c. of alcohol added, the mixture stirred, the solids (including precipitated pectin) removed by straining through linen, and the filtrate evaporated to 50 c.c., thus freeing it from alcohol and volatile substances. After acidification with sulphuric acid, the solution is extracted with ether for 20 hours in a Dunbar lactic acid or Palkin extractor. Thirty c.c. of water are added to the extract, the ether evaporated, and the solution shaken in a separating funnel with five successive 10 c.c. portions of chloroform to remove benzoic acid. The aqueous solution is steam distilled to remove volatile acids and the volume kept at 30 to 50 c.c. until 100 c.c. of the distillate require only 0·2 c.c. of 0·5 *N* sodium hydroxide solution for neutralisation. The solution from the distilling flask is rendered alkaline to phenolphthalein by adding powdered barium hydroxide, evaporated to 20 c.c., and neutralised by passing carbon dioxide through it. Barium citrate, malate and tartrate are then removed by adding to the cooled solution 67 c.c. of alcohol, and water to make up the volume to 100 c.c., shaking and filtering the mixture, and washing the precipitate with a mixture of alcohol and water (2:1). The filtrate and washings are evaporated to dryness, taken up with 10 c.c. of dilute alcohol, filtered and washed with the alcohol, dissolved in cold water, filtered free from any alcohol-soluble organic material, and an excess of hot quinine sulphate solution (0·5 to 1·0 grm. of sulphate) added. After rapid cooling, the precipitated barium sulphate and excess of crystallised quinine sulphate are filtered off, washed with water and alcohol to remove quinine sulphate, and the residue ignited and weighed as barium sulphate. The weight, multiplied by 0·7711, gives the corresponding weight of lactic acid.

D. G. H.

Fluorescence Reaction of Malic Acid. S. A. Celsi. (*Quim. e Ind.*, 1926, **3**, 205–206.)—The following test appears to be specific for malic acid :— Two or three drops of the solution are mixed in a test-tube with 2 c.c. of concentrated sulphuric acid and a small quantity of orcinol, and the liquid heated in a water bath for about 5 minutes, then cooled, diluted with 10 c.c. of distilled water, cooled again, and treated with concentrated ammonia solution, drop by drop, until the reaction is distinctly alkaline. The liquid then shows a blue fluorescence, which is best seen by placing the tube over a black ground and observing it laterally in either sunlight or magnesium light. If the ammonia is added carefully so as to form two layers, a fluorescent ring appears in the upper layer, whilst the lower remains colourless or pale yellow. The reaction, which is given by 0·00001 grm. of malic acid, is due to the formation of homo-umbelliferone. A similar effect is obtained if the orcinol is replaced by resorcinol, but the reaction is then given also by citric and acetylacetic acids. Positive results are obtained also with sodium, potassium, and calcium malates, but with lead malate, the liquid must be filtered before the ammonia is added. The sulphuric acid used must be quite free from nitrous compounds, and a blank test with the reagents must give a negative result. T. H. P.

Gravimetric Method for the determination of the Bases of the Diphenyl Series and a new Complex Salt of these Bases. W. Herzog. (*Chem. Ztg.*, 1926, **50**, 642–643.)—If a solution of benzidine in warm dilute acetic acid is treated with a 7 per cent. solution of mercuric chloride, the benzidine is precipitated quickly and quantitatively as the complex compound $(HgBzd)Cl_2$. The yellow crystalline precipitate is transferred to a tared filter paper or glass filter, washed free from mercury, and dried in a vacuum desiccator over sulphuric acid or phosphorus pentoxide till constant in weight. Five determinations of the same sample of benzidine gave extreme values differing by 0·13 per cent. The method may also be applied in certain cases to the determination of mercury, and also of *o*-toluidine. The preparations and properties of the corresponding bromides and iodides of benzidine and *o*-toluidine are also described. J. G.

Refractometric Determination of Fat in Oil Seeds and Oil Cake. H. Zander. (*Z. Unters. Lebensm.*, 1926, **51**, 324–335.)—A description is given of a method devised by Coleman and Fellows (1925) for the determination of the oil content of linseed and linseed meal. The method is a modification of that used by Wesson for cottonseed oil and depends on extraction with monochloronaphthalene, known in America as "halowax oil, No. 1000 or No. 1007," the refractive index of the resulting solution being then determined at 25° C. If 2 grms. of the linseed and 4 c.c. of "halowax" oil are used, the refractive indices of the solutions and the corresponding percentages of oil in the seed are : 1·61276, 30·0 per cent. ; 1·61215, 31 ; 1·61154, 32 ; 1·61093, 33 ; 1·61033, 34 ; 1·60973, 35 ; 1·60914, 36 ; 1·60855, 37 ; 1·60797, 38 ; 1·60738, 39 ; 1·60681, 40 ; 1·60623, 41 ; 1·60567, 42 ; 1·60510, 43 ; 1·60454, 44 ; 1·60399, 45 per cent. T. H. P.

Perilla Seed and Oil. (*Bull. Imp. Inst.*, 1926, **24**, 205–208 ; (*Cf.* ANALYST, 1921, **46**, 289.)—The following table embodies results of analyses of perilla seed from further cultivation tests.

Origin of seed.	Oil on moisture-free seed. Per Cent.	Sp. gr. at 15°.	$n_D^{40°}$	Acid value.	Saponification value.	Iodine value (Hübl 17 hrs.).	Unsaponifiable matter. Per Cent.
S. Africa, 1923	47·3	0·932	1·476	2·1	191·9	184·0	1·2
1925	44·6	0·932	1·4735	5·3	190·2	186·1	1·1
S. Rhodesia, 1923	40·0	0·931	1·473	21·6	190·7	179·9	0·9
1924	38·5	0·932	1·473	1·4	189·2	175·4	0·7
India, Naga Hills	47·2	0·931	—	28·1	197·6	189·0	—
Manipur	49·2	0·934	—	5·1	194·7	193·0	—
Hong Kong	40·2	0·933	1·4735	1·5	192·0	189·3	1·5
American specification	—	0·932 (min.)	—	5·0 (max.)	190·0 (min.)	191·0 (min.) (Hanus)	1·5 (max.)

D. G. H.

Natural Musk. A. Wagner. (*Chem. Ztg.*, 1926, **50**, 601–603.)—Thibetan or Tonkin musk is adulterated with dried blood, leather waste, leaden shot, peas, barley, crushed acorns, roasted liver, and powdered beef. The pouches should show no seam or spot pasted over with hair ; soaking in water will separate the hairs and render a cut visible. Added material may often be detected by careful examination of the contents of the pouch. If a trace of the material emits the odour of burnt horn, when heated on platinum foil, addition of blood or the like is indicated. Mercuric chloride should give, at most, a faint turbidity with an aqueous solution (1:200) of the musk ; if a precipitate is formed, either ammonium carbonate or the inferior Siberian or Russian musk (*Moschus Sibiricus, M. cabardinus*) has been added. An apparently sound musk pouch is sometimes quite worthless, owing to the fact that it has been punctured with a fine needle and the contents squeezed out into strong spirit or rum. This fraud may be recognised by the unevenness which it produces in the pouch. Genuine pouches should yield 50 to 60 per cent. of their weight of musk.

The price of musk fell from 9·75 dollars per oz. in 1914 to 7·15 dollars in 1916, and rose to 14·40 to 16·80 dollars in 1919. As principal consumer of musk France has now been displaced by the United States. T. H. P.

Microscopical Examination of Cotton Hairs. T. B. Bright. (*J. Text. Inst.*, 1926, **17**, T. 396.)—Two methods have been employed in this paper : (1) The Congo red test of Miss G. G. Clegg, and (2) the swelling test worked out by Fleming and Thaysen. The effect of these tests in full detail has been studied in cases of damage by heat, mechanical means, fungi and sulphuric acid. Photomicrographs are given.

Congo Red Test.—About 0·1 grm. of the cotton is thoroughly wetted, gently squeezed, placed in 11 per cent. sodium hydroxide solution, shaken thoroughly

and left for 5 minutes. After being washed rapidly it is placed in a saturated solution of Congo red (2 per cent.), shaken at intervals for 6 minutes, removed and washed till the wash water is no longer pink. It is then immediately placed in an 18 per cent. solution of sodium hydroxide, teased out, and a few hairs mounted in the same liquid for examination, the cover-glass being sealed with Langeron's cement. Undamaged cotton hair swells, and in places actually bursts, exposing a strip of white cellulose, but the cuticle remains intact and becomes stained a faint pink. In cotton damaged mechanically the cellulose becomes deeply stained, having the appearance of a bruise. Cotton damaged by heat, acid, or fungus shows a characteristically different appearance.

Swelling Test.—The cotton is treated with a mixture of carbon disulphide and 15 per cent. sodium hydroxide solution, examined under a low power, the damaged hairs counted against the undamaged, and expressed as a percentage. Swelling is complete in about 2 to 3 minutes, and, if the sample is undamaged, no further change occurs for about 30 minutes, after which the expanding cellulose bursts the cuticle. If the cotton has been severely damaged, the cuticle is torn and the cellulose is lacerated, plainly showing cracks in 20 minutes.

No general comparative statement as to the two tests can be made, their relative efficiencies varying according to the material. The following table shows the appearance of hairs damaged in different ways and submitted to the Congo red test. The range of temperature is from 110° to 190° C., but the manner of exposure influences the result. Immersion in 30 per cent. sulphuric acid for 48 hours shows no effect in this test, but 40 per cent. acid causes the appearance of irregular streaks and patches. Mechanical damage is unmistakable, and cannot be confused with that due to heat or the action of fungi. The last two, however, show points of similarity, but when a fungus was the cause there always remains some trace of the organism itself, and there is no sign of the broad spiral bands or the singed cuticle typical of damage by heat.

Degree of damage.	*Attacked by fungus.*	*Exposed to heat.*	*Mechanical.*	*Treated with acid.*
None.	Stained pink.	Stained pink.	Stained pink.	Stained pink.
Slight.	Narrow multiple red spiral bands.	Broad simple red spiral bands.	Surface bruises.	—
Moderate.	Stained evenly red.	Narrow multiple red spiral bands.	Deep cuts.	Irregular red patches.
Severe.	Stained red and cracked.	Stained red and cuticle singed.	—	—

R. F. I.

Inorganic Analysis.

Colorimetric Determination of Ferric Iron by means of Pyramidon. H. W. van Urk. (*Pharm. Weekblad*, 1926, **63**, 1121–1123.)—The blue coloration given by ferric salts with pyramidon can be used for the colorimetric determination of ferric iron. The iron solution, containing from 0·05 to 0·3 mgrm. of ferric iron per 100 c.c., is treated with 1 per cent. of pyramidon, dissolved in a little water,

and then with sufficient sulphuric acid to give a solution with an acidity between 0·1 and 0·2 *N*, and the colour compared with those given by standard iron solutions under the same conditions. The colour is affected if the acidity of the liquid exceeds the higher limit mentioned.

Determination of Sulphur in Iron. K. K. Järvinen. (*Z. anal. Chem.*, 1926, **68**, 397–404.)—Various sources of error are discussed, and the following method recommended: The drillings (5 grms.) are dissolved in a 300 c.c. conical flask in 100 c.c. of water, with the gradual and cautious addition of 8 to 9 c.c. of bromine. When solution is complete, the excess of bromine is removed by boiling; the cold solution is treated with 20 to 30 c.c. of 3*N* barium chloride solution and water to complete a volume of 100 to 150 c.c. After several hours' standing, the precipitate is collected and washed a few times with cold water. The paper is moistened with sodium carbonate solution, and incinerated expeditiously in a small platinum dish. The carbonaceous residue is fused with 1 grm. of alkaline carbonate and a little nitrate; fusion should not be unduly prolonged (sulphur content of coal gas). The aqueous extract is filtered, and the acidified filtrate precipitated with 20 c.c. of 0·2 *N* barium chloride; flocculation of the precipitate is promoted by addition of 10 to 20 drops of 1 per cent. lacmoid or Congo red solution. W. R. S.

Colorimetric Determination of Vanadium. J. Meyer and A. Pawletta. (*Z. anal. Chem.*, 1926, **69**, 15–20.)—Hydrogen peroxide gives with acidified vanadate solutions a brownish-red colour, which is bleached by excess of peroxide. The reaction was investigated, and it was found that the intensity of the colour depends upon the relative proportions of quinquevalent vanadium, hydrogen peroxide, and sulphuric acid. The red compound is not, as usually stated, pervanadic acid, but a peroxidised sulphate: $(VO)_2(SO_4)_3 + H_2O_2 \rightarrow [V(O_2)]_2(SO_4)_3$. This product, together with more peroxide, yields light-yellow orthoperoxovanadic acid, $H_3[V(O_2)O_3]$. Increase in the sulphuric acid concentration restores the reddish-brown colour: $[V(O_2)]_2(SO_4)_3 + 6H_2O \rightleftharpoons 2V(O_2)(OH)_3 + 3H_2SO_4$. A considerable excess of acid is therefore required, as well as a minimum excess of peroxide over the ratio $V:H_2O_2 = 1$. The substance to be tested is fused with carbonate and nitrate; the mass is dissolved in 15 to 20 per cent. sulphuric acid, and the solution, after some minutes' standing, treated with one drop of 3 per cent. hydrogen peroxide for small quantities of vanadium. A sensitiveness of 1:160,000 is claimed. W. R. S.

Volumetric Determination of Hypophosphites. I. M. Kolthoff. (*Z. anal. Chem.*, 1926, **69**, 36–38.)—In Köszegi's method (ANALYST, 1926, **51**, 426), the neutral or alkaline solution is boiled with permanganate for the complete oxidation to the phosphate. It is pointed out that permanganate suffers slight decomposition on boiling, especially in presence of manganese peroxide, which acts as catalyst. Theoretical values can be obtained as follows: Twenty c.c. of hypophosphite solution (0·1 *N*) are treated in a glass-stoppered conical flask (previously

cleaned with chromic acid) with 50 c.c. of 0·1 *N* permanganate and 10 c.c. of 4 *N* sulphuric acid. After 24 hours' standing, 1 to 1·5 grm. of potassium iodide is added, and the excess of oxidiser ascertained with thiosulphate. Two blank tests (25 c.c. permanganate, 5 water, and 5 of 4 *N* sulphuric acid) are treated in the same manner as the assay. W. R. S.

Physical Methods, Apparatus, etc.

Weighing by Hydrostatic Compensation. M. Guichard. (*Bull. Soc. chim.*, 1926, 1113–1115.)—An application of the author's hydrostatic compensation balance (*id.* 1925, **37**, 251) is described which may be constructed from any existing balance without loss of sensitiveness, and which enables continuous weighings to be made in any desired atmosphere and at variable temperatures. The substance to be weighed is suspended from one arm of the balance in a special container in which the required conditions may be maintained, and is counterpoised by a plunger attached to the other arm. The plunger dips into a reservoir of oil connected by means of a U-tube with a burette placed outside the balance case. The weighings are carried out by compensating any change in weight by means of an alteration of the level of the oil in the burette. The balance is calibrated by determining the volume of oil equivalent to a given change in weight. J. G.

The Falling Drop Method for the Determination of Specific Gravity. H. G. Barbour and W. F. Hamilton. (*J. Biol. Chem.*, 1926, **69**, 625–640.)—The method described by Barbour and Hamilton (*Amer. J. Physiol.*, 1924, **69**, 654) for specific gravity determinations has been simplified and rendered more sensitive. A 10 c.mm. drop of fluid is timed as it falls over a distance of 30 cm. through a mixture of xylene and bromobenzene in a tube of exactly 7·50 mm. bore. Its falling time is compared with that of a 10 c.mm. drop of standard potassium sulphate solution of known density. By the use of an alignment chart, which corrects for room temperature, it is possible to calculate the unknown density with an accuracy of 1×10^{-4}. The mixture through which the drop of body fluid falls should have a low viscosity and a specific gravity somewhat below that of the fluid. It consists of 2 substances, one heavier and one lighter than the range of fluids to be tested, so that by adjusting the proportions the specific gravity of the mixture can be adapted to the expected conditions. Xylene and bromobenzene were found satisfactory for the mixture. The most essential improvement in the procedure is that no determination of the exact density of this mixture is required, but merely the falling time of a salt solution of standard density. The procedure and calculation are described in detail. The method may be used for the determination of the concentration of various solutions, not necessarily aqueous solutions such as blood and serum, but oily substances dissolved in bromobenzene or some other fat solvent. Such solutions must be dropped through an aqueous solution of appropriate density. For extreme accuracy it is safer to calculate from curves drawn directly on a logarithmic background, and not from an alignment chart. P. H. P.

Electrolytic Separations by Graded Potentials. A. Lassieur. (*Bull. Soc. chim.*, 1926, **39**, 1167–1183.)—Working instructions are given for the separation by the method of graded potentials of the metals antimony, bismuth, copper, lead, tin, cadmium, and zinc in bearing metals, bronzes, and commercial alloys. The respective "auxiliary potentials" at which these metals are deposited were determined by connecting the cathode and an auxiliary calomel electrode in series with a millivoltmeter and a high resistance. Provision was also made for a variable electrolysing current. Zinc may be deposited quantitatively from an acid medium (P_H, 4·5), though better deposits, but slightly high results, are obtained in alkaline solutions. The best results, however, are obtained in the presence of ammonium cyanide, so long as the exact quantities of reagents are used. The presence of the nitric acid used to dissolve the metal originally affects the deposition of zinc in an acid medium, but not in the presence of a cyanide, and, if very little is present, it may become reduced during the separation. Details are also given for the separations of cadmium, zinc and tin, and of antimony, copper, lead, and tin from a solution containing cadmium, and it is shown that no cadmium is entrained during the separations. J. G.

Dyes for Artificial Daylight Shades. (*Textile Colorist*, 1925, **47**, 717; *J. Text. Inst.*, 1926, **17**, A 166.)—The light from an ordinary tungsten filament lamp can be made to resemble daylight with sufficient accuracy for most purposes by being transmitted through a gelatin sheet stained with the following dyes:—Toluidine blue, 1·2; filter violet, 0·1; fast red D, 0·1; methylene blue, 1·2; rapid filter red I, 0·16; and orange II, 0·08 grm. per sq. m. of gelatin. The dyes are dissolved separately and then mixed with weak gelatin solution before being applied to the sheets.

References to Scientific Articles not Abstracted.

INSULIN AND ITS MANUFACTURE. By F. H. CARR. *Chem. and Ind.*, 1926, **45**, 750 (Oct. 15).

History of discovery—Physiology—Insulin and fat metabolism—Chemical properties—Physiological assay—Preparation—Clinical use.

INDUSTRIAL CHEMICALS FROM THE SEA. By G. M. DYSON. *Chem. Age*, 1926, **15**, 390 (Oct. 23).

Solid matter in sea water—Processes of producing salt—Importance of shape of crystals (diagrams)—By-products from solar salt—Iodine from seaweed—Potash from seaweed—Edible seaweed.

GROWTH OF THE DYESTUFFS INDUSTRY. By R. E. ROSE. *J. Chem. Education*, 1926, **3**, 973 (Sept.).

Historical review with portraits of chemists and specimens of dyed fabrics.

THE CARE AND CUSTODY OF BOOKS. By F. W. CLIFFORD. *Chem. and Ind.*, 1926, **45**, 793 (Oct. 29).

Arrangement of technical library—Shelving—Selection of books—Collation—Cataloguing—Systematic subject index—Binding—Protection of bindings.

Reviews.

OLLOID AND CAPILLARY CHEMISTRY. By Prof. Dr. HERBERT FREUNDLICH. Translated by H. STAFFORD HATFIELD, Ph.D. Pp. xv. + 883. With 157 Diagrams and 195 Tables. London: Methuen & Co. 1926. Price 50s.

URFACE CHEMISTRY. By E. K. RIDEAL, D.Sc., F.I.C. With a Preface by Prof. F. G. DONNAN. Pp. vi. + 336. Cambridge: The University Press. 1926. Price 18s.

The development of Colloid Chemistry from the time of Graham has shown hat his classification (based on diffusion of solute through membranes) into two lasses of matter, crystalloids and colloids, holds only as a special case. Colloid hemistry now embraces the study of the phenomena accompanying the dispersion f a phase in some other (continuous) phase. Consequently, various workers ave sought to rename Colloid Chemistry so as to imply that the study concerns ıatter in a fine state of dispersion. The essential fact is that when a phase is ubdivided so as to reach a zone of colloidality, the separating boundary or inter- ıcial area is enormously extended. This results in a great intensification of he forces concerned at interfaces. Particularly important both for theory and echnology is the phenomenon of adsorption at interfaces. Whether the colloidal ondition is reached by continued subdivision of a phase or by the building up from he molecular state the result is the creation of an enormous interface area.

Emphasis may be laid either on the phenomena specifically associated with ıterface area or on the general properties of colloid systems—colour, particle ize, phase/volume ratio, etc. Emphasis in both directions has been effected by 'rof. Freundlich in his book, as suggested in the dual title.

Capillary Chemistry deals with the physical chemistry of interfaces, and is ractically synonymous with Surface Chemistry, as implied by Dr. Rideal. The road scope of the subject includes the formation of new phases, the inter-conversion f phases, and molecular motion. These are the foundations of general colloid hemistry.

Prof. Freundlich's book is based on his well-known *Kapillarchemie* (1909), ut has been re-written and greatly extended. The whole range of colloid henomena is surveyed, thousands of references to the literature being made. he result is a book of enormous value to all students of the subject. As a work f reference on Colloid Chemistry it has no equal; to the advanced student it is eally indispensable. The author's reputation is a sure guarantee of the quality f the book. The translation has been well done and is from the third German dition, this bringing the subject matter up to 1923.

Freundlich accepts Ostwald's classification of colloid systems, distinguishing etween the following interfaces:—liquid/gas; liquid/liquid; solid/gas; solid/liquid;

solid/solid. The treatment follows this order, and is descriptive rather than deductive. Surface and interfacial tensions and the phenomena accompanying them are discussed in great detail. Every possible aspect of colloid investigation has been touched on, generally with marked success. The author is a keen critic and ever ready with new ideas. The account of capillary-electric phenomena is the best yet presented, but the treatment of emulsions is brief and requires considerable amplification.

The emphasis laid on interface phenomena has been rewarded in recent years by the investigations of Hardy, Langmuir, and Harkins, who independently reached the idea of molecular orientation at interfaces. A new branch of chemistry dealing with such adsorption has been built up, based on extremely accurate experimental work and sound thermodynamical reasoning.

A prominent worker in this field is Dr. Rideal, and his book, *Surface Chemistry*, ably presents modern research and its results. It supplements Freundlich's book. Treating surface and interfacial tension in detail and following Freundlich fairly closely, it proceeds, not to general colloid chemistry, but to a study of the molecular structures and kinetics of surfaces. A new two-dimensional world has been revealed, the study of which is essential to future progress in colloid science and its industrial applications.

Detailed discussion centres round such matters as the Gibbs adsorption equation, unimolecular layers, expanded films, spreading on solid surfaces, the surface energy of solids, crystal growth, the Helmholtz double-layer, electrokinetic phenomena, Brownian motion, Donnan membrane equilibrium, coagulation and precipitation. A final chapter on gels and hydrated colloids critically reviews the facts and theories of orthodox colloid chemistry. There is an excellent discussion on emulsions, but it is surprising to find no account of froths or foams, so important from the "surface" point of view and so pregnant with technical applications.

Dr. Rideal's book is timely, and the student wishing to be abreast of modern research must be grateful for this assistance. The style is lucid, and the mathematical and thermodynamical sides of the subject have been presented in particularly clear fashion. Problems for further investigation are frequently indicated, and the book conveys the impression of being the work of an enthusiastic investigator. The printing and binding are excellent.

WILLIAM CLAYTON.

THE PREPARATION AND ANALYSIS OF ORGANIC COMPOUNDS. By J. BERNARD COLEMAN, A.R.C.Sc., F.I.C., and FRANCIS ARNALL, Ph.D., M.Sc., F.I.C. Pp. xvi. + 352 + 24. 42 Illustrations. London: J. & A. Churchill. Price 15s. net.

This book contains a comprehensive course of practical organic chemistry fully sufficient to meet the requirements of an honours degree student. It is

divided into four sections, each of which is further subdivided into numbered paragraphs, an arrangement which greatly facilitates the tracing of cross-references. Section I is a concise account of the general processes of organic manipulation; Section II contains a comprehensive series of 89 preparations arranged in families of related compounds, each preparation being prefaced by a brief theoretical discussion; Section III deals with qualitative; and Sections IV and V with quantitative organic analysis.

To compress an honours course of practical organic chemistry into 352 pages involves much picking and choosing of material, and here, of course, opinions will differ as to what should, and should not, go in. On the whole, one cannot but commend the authors on their selection, but it is to be regretted that they have not found it possible to allot more than 22 pages to Section I. Manipulation is the basis of practical organic chemistry, and the section dealing with it should be the last to be curtailed, more especially in a book which, according to the preface, is intended to obviate the necessity for constant supervision of the average student.

There are no discussions on such important matters as distillation in superheated steam, fractional crystallisation and mechanical agitation. The employment of an autoclave is recommended in some experiments, but beyond a diagram there are no hints to the student on its use. Distillation under reduced pressure deserves more than one page; at least the student might have been enlightened as to the wonderful properties of cellulose acetate "dope," and the manner in which it enables the harassed chemist to obtain a good vacuum even when all the bungs are not "of sound rubber, neatly bored" (p. 8). Rubber is not always admissible when dealing with organic liquids.

The employment of a Kipp apparatus to generate carbon dioxide for the Dumas estimation of nitrogen is to be deprecated; the apparatus described by Farmer (*J. Chem. Soc.*, 1920, **117**, 1446) much more readily gives pure carbon dioxide free from air. The Robertson method for the estimation of halogen (*J. Chem. Soc.*, 1915, **107**, 902) and the Hewitt-Jones method for the estimation of methoxyl (*J. Chem. Soc.*, 1919, **115**, 193) are so convenient as compared with the older classical methods that they would seem worth a place, even though their inclusion necessitated the curtailment of the treatment of the Meyer and Dumas vapour density methods; presumably the honours degree student takes a course of practical physical chemistry.

Finally, the educative value of the book could be increased by the provision of references to the literature. From the beginning the student should be encouraged to consult the original accounts of the experiments he is making; his chemistry, his knowledge of the literature and his scientific French and German are all alike improved.

These points, however, are matters of opinion as to what should be included, rather than definite flaws in the execution of the work, and are of small importance when contrasted with the general excellence of the book. The preparations given

have been well chosen and well described, and the arrangement of them is particularly to be admired. Much of the section on the qualitative identification of organic compounds is original; it contains a definite scheme of analysis and 37 detailed tables giving the characteristics of about 650 compounds. Equipped with this scheme the student will have little difficulty in dealing even with such classics as a mixture of aniline oxalate and oxanilide. It is only to be expected that the whole of the analytical sections should be first class, having regard to the connection of one of the authors with two well-known text-books on inorganic analysis. In spite of the multitude of its predecessors this volume well justifies its publication.

The printing and binding are excellent, and proof reading has been well done.

T. S. WHEELER.

PRACTICAL GLASS MANIPULATION. By D. G. BRIGGS. Pp. xvi. + 40. London: Crosby Lockwood & Co. Price 2s. 6d.

There is a peculiar fascination about glass blowing, and many who have watched an expert at work must have felt a desire to emulate his dexterity. To the worker in either the physical or chemical laboratory, the ability to construct simple apparatus is a very valuable asset.

Mr. Briggs's little book will prove of real value to the novice who has no opportunity of attending a course of instruction in the subject. It is essentially practical and amply illustrated. All the important points are clearly emphasised, so that, if the instructions are carefully followed, anyone, with practice, can obtain at least a moderate degree of proficiency in the minimum of time. The apparatus required consists almost entirely of appliances commonly found in any laboratory, and a complete list is given, including even carron oil for burns !

The book should find a place in every teaching laboratory; not merely in the science master's library, but in the laboratory itself, and accessible to senior students. Nor is it to be despised by the practising analyst, who will find it useful as an aid to his memory in recalling half-forgotten manipulations.

R. W. SLOLEY.

INDUSTRIAL CHEMISTRY. Edited by ALLEN ROGERS. Fourth Edition. Vol. I. pp. 511; Vol. II. pp. 1267. London: Constable & Co. Price 52s. 6d. net.

This "Manual for the Student and Manufacturer" (with the earlier editions of which the reviewer had no acquaintance) will form for very many chemists a useful source both of information and of reference. Like most comprehensive works of the present day, it is a collection of monographs by specialists compiled under the supervision of a single editor; and, as one would expect, the separate portions vary considerably in merit; less in the matter of completeness of information than in the way in which it is conveyed. The book is published in two

volumes—an inorganic and an organic division; and the subject matter is divided into forty-nine chapters—General Processes; Water for Industrial Use; Fuel and Power Generation; Sulphuric Acid; Nitric Acid; Salt and Hydrochloric Acid; Elements and Compounds; Chlorine and Allied Products; Electrochemical Industries; Lime, Cement and Plaster; Clay, Brick and Pottery; Glass; White Lead; Zinc oxide and Lithopone; Pigments and Paint Oils; Mixed Paints; Carbon; Iron and Steel; Fertilisers; Commercial Organic Chemicals; City Gas; Industrial Gases; Coal Tar and its Distillation Products; The Petroleum Industry; Destructive Distillation of Wood; Oils, Fats and Waxes; Linseed Oil; Hydrogenation of Oils; Lubricating Oils; Soap and Soap Powder; Glycerin; Laundering; Essential Oils, Perfumes, Flavouring Materials, and Synthetics; Resins, Gums, Turpentine, and Shellac; Rubber and related Gums; Varnish; Sugar; Starch, Glucose, Dextrin, and Gluten; Textiles; Dyestuffs and their Application; Paper-making; Cellulose Industries; Leather; Explosives; Glue and Gelatin; Casein; Dehydrated, Dried, Evaporated, and Condensed Foods.

It is clear that with an average space of twenty-five pages no very detailed account of an industry can be expected; and though three or four chapters—water, sulphuric acid, city gas, and leather—extend much beyond this, some of the others are correspondingly compressed. Most of the work, when this is borne in mind, is very well done, and the information seems on the whole well up to date; and the compression is in most cases compensated for by the inclusion, at the end of the chapter, of a good bibliography—naturally, like the descriptions of industrial practice, having an American leaning.

In the Section on waters, a valiant attempt is made, with the help of "reaction coefficients," "character values," "foaming coefficients," and "coefficients of scale hardness," to classify waters quantitatively or numerically with regard to their fitness for boiler use; but most users will consider that these figures, in the present state of our knowledge, must be received with very great caution. The sections on fuel and on sulphuric acid are very well done. The weak places in the book are the chapters on "Elements and Compounds" and "Commercial Organic Chemicals"; each of these consists of a list of substances, giving in most instances little more information than the name, source, and chief applications. When it is stated that the first chapter, in 39 pages, deals with 225 substances, and includes descriptions of the Leblanc and ammonia soda processes and of the Frasch process for sulphur production, and that the second, in 7 pages, deals with 50 compounds, including such important substances as oxalic and tartaric acids, saccharin chloroform and ether, it will be obvious that these chapters can be of little or no value to anyone, and in my view, it would have been better to omit them.

The Section on city gas is long and full, and in the descriptions of plant and processes quite good; but it is very badly written, crowded with misprints (indeed throughout the book the number of misprints is quite inexcusable, especially in a fourth edition), loose phraseology, and bad grammar. The "theoretical" or explanatory portions suggest that the author has no underlying chemical

knowledge; the quotations, "We probably have reactions similar to all three of the previous theories," and "a connection between the proportion of ammonia and cyanogen which has been explained by the probable reaction $NH_3 \begin{cases} 2CN + 3H_2 \\ N_2 + 3H_2 \end{cases}$" will illustrate what I mean.

Almost the whole of the book needs revision and good proof reading, to correct both misprints and awkward or ungrammatical phraseology. On one page I find ten corrections of misprints necessary; the melting point of common salt is given on one page as 815° and on another as 772°; in the preface, the "fabric of American industry" is described (unintentionally) as "contemplating the appearance of a third edition," and at the same time "shaping itself into a marvelous structure"; in another place, substances are described as reacting "in a manner calculated to produce" sulphuric acid, and acid formed in the last chamber is said to flow forward into the next; in yet another a substance is put into a vessel "having an iron lid, which is then carefully diluted"; and what the shade of Oliver Wendell Holmes would have to say to an American who refers to the "wonderful one-hoss *chaise*" one trembles to think. But the irritation which these things cause is more than soothed by occasional phrases that flash upon the vision—by the charming frankness, for example, of the statement that, when making Glauber's salt "if it is desired in large crystals (*to adulterate crystal soda*) the coolers are made of heavy planking." The italics are mine.

It is a great pity that the book is disfigured by these blemishes, which could so easily have been removed; for it is a really valuable compendium, and contains, gathered together, a large amount of useful information, from widely scattered sources. In spite of its faults, it is a book well worth having.

J. T. DUNN.

REPORTS ON THE PROGRESS OF APPLIED CHEMISTRY. Vol. 10, 1925. Published by the Society of Chemical Industry. Price 7s. 6d. to members, 12s. 6d. to non-members.

The latest volume of this now familiar series does not differ in its general features from its predecessors. It comprises 23 sections, one less than the previous year; "Explosives" and "Sanitation and Water Purification" are not included, whilst "Non-ferrous Metals" reappears. The list of contributors differs in several cases from that of the preceding one. The year 1925 seems to have been one of general progress in the various branches of applied chemistry; in spite of the enervating effects of the prevailing industrial depression, future prospects are described as favourable. Unfortunately, as we are all painfully aware, the situation has since become considerably worse. Of particular note is the rapid development of the British beet sugar industry, resulting from the financial aid which it has received from the Government.

Dr. Monier-Williams (on "Foods") summarises recent advances in our knowledge of the accessory food factors, referring particularly to the discovery that

vitamin *A* is formed from sterols by the action of ultra-violet radiation. He anticipates future commercial exploitation of this method of activating foodstuffs such as margarine. Attention is drawn to recent work on the position of iodine as an essential constituent in a dietary. New developments in the analysis of milk and dairy products are briefly described, and a study of Dr. Tocher's monograph on "Variations in the Composition of Milk" is recommended. Reference is made to the new Preservatives Regulations and to the necessity for research work on several points of analytical interest connected therewith.

The various sections include the usual very complete lists of references; only one typographical error was noticed.

A. F. LERRIGO.

EDIBLE AND POISONOUS FUNGI. Miscellaneous Publications No. 54. Ministry of Agriculture and Fisheries. H.M. Stationery Office. 1926. Price 3s. cloth, 2s. 6d. boards. (Post free.)

An analyst is liable to be consulted on all sorts of unusual subjects, and one does not need much imagination to think of cases in which a knowledge of the characteristics of the more common fungi might be indispensable. The first edition of this little handbook, published in 1910, has long been out of print, and in view of the constant demand, the Ministry of Agriculture has issued this new edition, in which the nomenclature and descriptive text have been brought up to date.

The 25 coloured plates have been admirably reproduced, and, studied with the text, should enable any careful observer to recognise the variety indicated. Most of the species represented belong to the *Agaricaceae*, and include those which are most likely to be mistaken for common mushrooms, but representatives of four other families are also given.

Apart from the "death cap" (*Amanita phalloides*), the chemistry of the poisonous fungi has been but little studied, and in toxicological work recognition of the structural form is still the most important test.

Although this little handbook does not profess to do more than to deal briefly with the more common varieties of edible and poisonous fungi, it will be found useful for rapid reference before consulting the larger text-books. For the benefit of those ignorant of botany, it gives a concise glossary of the technical terms used in the text.

EDITOR.