MARCH, 1917. Vol. XLII., No. 492.

# THE ANALYST.

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

THE annual general meeting of the Society was held on Wednesday evening, February 7, in the Chemical Society's Rooms, Burlington House. The President, Mr. G. Embrey, F.I.C., occupied the chair.

The minutes of the previous annual general meeting were read and confirmed.

Mr. N. Evers and Mr. W. H. Simmons were appointed scrutators of the ballot-papers for election of Officers and Council for 1917.

The Acting Hon. Treasurer (Mr. E W. Voelcker) presented the accounts of the Society for 1916, and votes of thanks were passed to him, to the Hon. Secretaries, and to the Auditors.

Mr. H. F. Stephenson and Mr. N. Evers were appointed auditors of the Society's accounts for 1917.

The President delivered his annual address.

Mr. A. CHASTON CHAPMAN proposed that a hearty vote of thanks be accorded to the President for his Address, and that his permission be asked to print the Address in the ANALYST. Referring to the question of training of analytical chemists, Mr. Chapman said that he hoped it would not be thought by Mr. Embrey, or by any other member, that he (Mr. Chapman) intended the remarks on this subject in his Presidential Address last year to be regarded as exhaustive. He realised how wide and complicated the subject was, and, regarding it merely from one point of view, had made certain suggestions which seemed to him of considerable importance, but which certainly did not exhaust the matter. The subject was one to which proper attention would have to be given before very long. The position of analytical chemistry in this country was not what it ought to be, and the sooner changes were made the better it would be, not only for those directly concerned, but for the welfare of the country.

Mr. L. ARCHBUTT, in seconding, expressed the opinion that if, as Mr. Chapman had suggested, analytical chemistry were properly established at the colleges, with professors devoting their whole time to it, the teaching would be so much better done than at present that probably the subject would be better taught at the college than in the working laboratory. Students now spent such a limited time at the technical college that the result was rather a neglect of pure science. They should stay there long enough to get a thorough grounding in the principles of science, and should be encouraged, if they could afford it, to stay on still longer as post-graduate students, when they might with advantage devote themselves to technical work.

The resolution, on being put to the meeting by Mr. Chapman, was carried by acclamation.

The President, in responding, said that he was in full agreement with the views of Mr. Chapman and Mr. Archbutt, merely wishing to emphasise the need for the teaching of analytical chemistry in a thoroughly practical manner.

The scrutators having reported the result of their examination of the ballot-papers, the President announced the election of Officers and Council for 1917 in accordance with the Council's nominations, as follows:

*President.*—G. Embrey, F.I.C.

*Past-Presidents serving on the Council (limited by the Society's Articles of Association to* 8 *in number).*—L. Archbutt, F.I.C.; Edward Bevan, F.I.C.; A. Chaston Chapman, F.I.C.; Bernard Dyer, D.Sc., F.I.C.; Otto Hehner, F.I.C.; R. R. Tatlock, F.I.C.; E. W. Voelcker, A.R.S.M., F.I.C.; J. Augustus Voelcker, M.A., B.Sc., Ph.D., F.I.C.

*Vice-Presidents.*—Harold G. Colman, D.Sc., Ph.D., F.I.C.; J. T. Dunn, D.Sc., F.I.C.; C. A. Hill, B.Sc., F.I.C.

*Hon. Treasurer.*—E. Hinks, B.Sc., F.I.C.

*Acting Hon. Treasurer.*—E. W. Voelcker, A.R.S.M., F.I.C.

*Hon Secretaries.*—P. A Ellis Richards, F.I.C.; E. Richards Bolton, F.I.C.

*Other Members of Council.*—W. T. Burgess, F.I.C.; T. W. Glass, B.Sc., F.I.C.; H. G. Harrison, M.A., F.I.C.; G. N. Huntly, B.Sc., A.R.C.Sc., F.I.C.; P. H. Kirkaldy, F.I.C.; S. J. C. G. Macadam, F.I.C.; W. Macnab, F.I.C.; W. Partridge, F.I C.; W. H. Roberts, M.Sc., F.I.C.; E. Russell, B.Sc., F.I.C.; H. L. Smith, B.Sc., F.I.C. ; J. Webster, F.I.C.

An ordinary meeting followed the annual meeting, the President being in the chair.

The minutes of the previous ordinary meeting were read and confirmed.

A certificate of proposal for election to membership in favour of Professor A. F. Joseph, D.Sc., A.R.C.Sc., F.I.C., was read for the second time; and a certificate in favour of Mr. Hubert Charles Siegfried de Whalley, chief chemist to the Molassine Co., Ltd., Tunnel Avenue, East Greenwich, S.E., was read for the first time.

Mr. G. W. Baker was elected a member of the Society.

The following papers were read: "The Shrewsbury and Knapp Process for the Estimation of Coconut Oil," by G. D. Elsdon, B.Sc., F.I.C., and Cyril R. Bagshawe; and "The Detection of Rose Petals in Blue Pill," by W. Partridge, F.I.C.

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# THE DETECTION OF ROSE PETALS IN BLUE PILL.

By WILLIAM PARTRIDGE, F.I.C.

(*Read at the Meeting, February* 7, 1917.)

In a paper entitled "Report on the Strength and Condition of Commercial Specimens of *Hydrargyrum cum Creta, Pilula Hydrargyri,* and *Unguentum Hydrargyri*" (*Year-Book of Pharmacy,* 1884, p. 566; and *Pharmaceutical Journal,* 1884, September 20), M. Dechan and T. Maben describe a test for the detection of hips in blue pill. At that time the current British Pharmacopœia was the edition of 1867 with "Additions" of 1874. This volume contained as an official preparation a confection of hips (*Confectio Rosæ Caninæ*) prepared from the fresh fruit of the dog-rose previously deprived of the achenes. This was used as a pill basis for *Pilula Quiniæ,* and, being little more than half the price of confection of rose, was doubtless sometimes used as a substitute for the latter in other pills. In their scheme for the analysis of blue pill, Dechan and Maben digested a quantity of the pill in warm strong acetic acid for the purpose of dissolving any oxides of mercury. They used the colour of the acetic acid extract to determine whether the pill had been prepared in accordance with the official formula—*i.e.*, with confection of rose. They stated the solution to be of a bright pink when this article had been used, whereas if confection of hips had been substituted for it, the colour of the acetic acid solution would be dirty-grey or brown. These authors examined eight samples of blue pill, and, on the strength of the colour test, described five as being made with confection of hips. This statement has been widely repeated, and even occurs in the nineteenth edition of Squire's "Companion."

Several samples having distinct odour of rose, some of which were from reliable sources, gave a brown acetic acid extract, although a further addition of confection of rose to the samples resulted in a bright pink acetic acid extract. Microscopical examination of these samples showed the presence of petals. Mr. A. E. Bell suggested that gradual destruction of the colouring matter of the petals might take place in the compounded pill, and this I find to be the case. Sometimes, however, even a newly made pill will only give a very faint pink coloration to acetic acid. It is evident that the test, when negative, is of no significance. As the pill mass may be kept for two years or longer before sale, there is often ample time for the alteration of the red pigment to a condition in which it fails to respond to the test, even though it may do so when freshly made.

During the process of preparing, first the confection of rose, and afterwards the pill, the rose petals are usually very much disintegrated, and direct microscopical examination of the pill is not very satisfactory, chiefly because the mercury globules obscure the appearances of the other elements. If, however, a portion of a pill be boiled with water, the larger proportion of the mercury settles almost immediately. The liquid, which contains most of the petals and that part of the liquorice root that has not gone into solution on boiling, can be poured off into a sedimenting vessel, and when settled, the deposit examined. If the magnification be sufficiently high ( × 500) portions of the rose petals will be recognised.

The pigment in the rose petal is contained in chromoplastids, which show up well in a microscopical examination of confection of rose. In samples of blue pill that have been made some time the pigment of the chromoplastids is replaced by a brown substance.

The acetic acid extract of a pill giving Dechan and Maben's test shows a broad band in the green when examined spectroscopically. Nothing characteristic has been seen in the spectra of genuine samples not giving the test.

### DISCUSSION.

Mr. E. T. **BREWIS** said that the 1885 Pharmacopœia mentioned two kinds of confection of roses—namely, *Confectio Rosæ Caninæ* and *Confectio Rosæ Gallicæ.* The former was made from the flowers of hips pulped with sugar, the latter from the petals of the red rose pulped with sugar. Blue pill was made with *Confectio Gallicæ,* and quinine pill with *Confectio Rosæ Caninæ.*

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## THE SHREWSBURY AND KNAPP PROCESS FOR THE ESTIMATION OF COCONUT OIL.

BY G. D. ELSDON, B.SC., F.I.C., AND CYRIL R. BAGSHAWE.

(*Read at the Meeting, February* 7, 1917.)

SINCE the Shrewsbury and Knapp process was first published (ANALYST, 1910, **35**, 385) various papers have appeared in connection therewith. Ross, Race, and Maudsley (*ibid.*, 1911, **36**, 195) seem to find no difficulty with the process, although they suggest that the maximum figure for butter should be increased. Cribb and Richards (*ibid.*, 1911, **36**, 327) do not see that the process has any advantage over the Reichert-Polenske process, but they have nothing to say of any difficulties of manipulation. Revis and Bolton* (*ibid.*, 1911, **36**, 334) state that they have found it impossible to obtain concordant results with the same samples, and they suggest a modification which, they say, gives satisfactory results, and which was favourably commented upon by Macara at the ensuing discussion; but the figures which these authors give do not bear out their claims. This point will be discussed later. Cranfield (*ibid.*, 1911, **36**, 446) speaks more or less favourably of the method, but considers the only advantage it has over the Polenske method to be one of speed. Shrewsbury and Knapp subsequently replied to these criticisms (*ibid.*, 1912, **37**, 3).

* This modification, as stated by Bolton and Revis, was only intended to obviate some apparent sources of error in the original process. It was evidently not critically pursued by them, as they state that the results obtained by the Reichert-Meissl-Polenske process are quite satisfactory and afford all the evidence required.—EDITOR.

Preliminary experiments made by the authors on a large number of samples of butter, using the original process, as described by Shrewsbury and Knapp, gave results varying from 24·5 to 37·9, some of these results, therefore, being considerably higher than those obtained by Ross, Race, and Maudsley, and by Cranfield. The samples, however, were not of known purity, though they were normal in all other respects. Duplicate results were, moreover, not particularly satisfactory, for whilst in some cases good agreements were obtained, in other cases duplicates differed by as much as 3·5 to 4·0 c.c., and in the case of a mixture of equal parts of coconut oil and butter fat the following three results were obtained: 76·6, 73·0, 70·1.

The process meets such an obviously long-felt want, in that it makes use of the typical acids of coconut oil—lauric and myristic, which together form more than 60 per cent. of the oil (*ibid.*, 1913, **38,** 8)—in place of those which occur in smaller quantities, and which go to form the Polenske figure, that it was considered worth while to continue the experiments further, using all possible precautions. The measurements of alcohol and water were all made with carefully graduated pipettes, and the final measurement of the alcoholic solution of the fatty acids was made in a graduated flask. The results were, however, little better, and the process in its original form had to be abandoned.

Various modifications were attempted. Following the suggestion of Shrewsbury and Knapp in their second paper (*loc. cit.*), the separation of the fatty acids from the alcohol was allowed to take place in a bath at 37° C., but the results were no better.

As it is evident that the main possibility of error lies in the different rates of separation of the insoluble acids from the alcoholic solution, endeavours were made to overcome this. For example, the length of time given to the separation was increased by varying amounts, up to two hours, but the results obtained, although somewhat better and considerably higher, were still far from being satisfactory. Finally, the process in this form had to be abandoned, as it was impossible to standardise the rate of rise of the globules of the fatty acids.

The modification due to Revis and Bolton was next tried, the process being carried out exactly as described by them. At first the results obtained seemed to be more hopeful, but once again duplicates did not agree well. The reason for this was found to be that the results obtained are affected to a surprising extent by slight variations in the strength of the alcohol used, the differences being due, therefore, to the varying amounts of water retained by the filter-paper. Various methods of drying were tried, but the only one found to be really satisfactory was to leave the filter-paper exposed to the atmosphere for some hours—say overnight. This was found to be considerably more satisfactory than immediately drying the flask and filter-paper in the oven, although in cases where results are required quickly this method may be used. With this modification it was found possible to obtain quite concordant results—duplicate experiments frequently agreeing to 0·1 c.c. It was not found necessary, however, to boil under a reflux condenser, as complete solution was obtained before the boiling-point of the alcohol was reached.

The next point to be considered was the most suitable strength of alcohol to be used. Shrewsbury and Knapp suggested 60 per cent. by volume, and this figure is also adopted by Revis and Bolton, but neither quotes any experimental work to show that this is the best strength of alcohol to use. In order to discover the most suitable strength, experiments were made with a sample of coconut oil, with one of coconut-oil-free margarine, made by mixing equal quantities of lard and *premier jus* and with a mixture of genuine butters. The modified Shrewsbury and Knapp figure was then obtained on these, using alcohols of varying strengths. The strength of the alcohol is expressed in all cases in terms of the specific gravity at 15·5° C., this, in the opinion of the authors, being the most satisfactory method, as it is free from all ambiguity. The alcohol was prepared from industrial methylated spirit 64 degrees O.P. The results of the experiments are given in the following table:

TABLE I.—VARIATION OF THE SHREWSBURY AND KNAPP FIGURE WITH THE STRENGTH OF ALCOHOL.

| | Sp. Gr. of Alcohol at 15·5° C. .. | ·905 | ·910 | ·915 | ·9175 | ·920 | ·925 |
|---|---|---|---|---|---|---|---|
| *Results Obtained* | Margarine .. .. | 25·0 | 14·2 | 10·8 | 8·0 | 6·2 | 5·7 |
| | Butter .. .. | — | 29·8 | 18·4 | 15·0 | 12·0 | — |
| | Coconut oil .. | 105·4 | 104·3 | 102·4 | 102·0 | 102·0 | 94·6 |

From these results it seemed evident that the greatest difference between the figures for coconut oil and margarine would be obtained by using alcohol of sp. gr. 0·920. Further work, however, made it clear that this difference was by no means the only factor to take into consideration, for when the figures for mixtures of butter and margarine of varying strengths with coconut oil are plotted it is found that the resulting curve is not a straight line, and, moreover, that its shape depends upon the strength of alcohol used; this is shown in the two curves. The figures obtained with alcohol of sp. gr. 0·910 are much more susceptible to small changes in the amount of coconut oil than those obtained with weaker alcohol, sp. gr. 0·920, but there are serious disadvantages in the use of this stronger alcohol. Thus, it is not possible to get such concordant results (the solutions are unstable, and are thus easily affected by slight changes in the conditions of the experiment), and also the figures for different samples of pure butter extend over a wider range; thus, for alcohol of sp. gr. 0·910 the range is about 12·0 (22-34), whilst for alcohol of sp. gr. 0·920 the range is only about 4·0 (9-13).

Taking these various factors into account, it appears that the strength of alcohol most suitable is sp. gr. 0·920 at 15·5° C., and this strength has therefore been adopted by the authors; figures are given for alcohols of other strengths, however, both for purposes of reference and to substantiate the suggestions put forward. With alcohol of this strength concordant figures can be obtained with mixtures of coconut oil and butter and coconut oil and margarine containing up to about 60 to 65 per cent. of coconut oil. With mixtures containing more coconut oil than this agreements are not so good, although this is made up to some extent by the greater differences in the results obtained by slight differences in the proportion of coconut oil present. Where, however, accurate figures are required in the case of mixtures containing upwards of 70 per cent. of coconut oil, it is better to use alcohol of sp. gr. 0·910. The figures obtained by the use of alcohol of both strengths are given in the tables.

The somewhat elaborate washing process adopted by Revis and Bolton has been used, but experiment has shown that it is really not necessary, and that once washing of the cake of fatty acids with 50 c.c. of cold water is all that is required.

It is important that the filtration be carried out as nearly as possible at 15·5° C. For all the experiments described in this paper a jacketed funnel has been used through which water at 15·5° C. is allowed to circulate, but this would not be necessary in ordinary routine work, except where the laboratory temperature was far removed from 15·5° C. It has been found that more concordant results are obtained by cooling the alcoholic solution to about 14° C., and violently shaking before the final adjustment to 15·5° C. is made.

*The Process Used.*—The process finally adopted is as follows: 5·0 grms. of the fat are weighed out into a 300 c.c. flat-bottomed flask (Reichert flask), and saponified by heating with 15 c.c. of glycerol-soda over a naked flame until the liquid suddenly clears. (The glycerol-soda is made by mixing together 700 c.c. of glycerol and 200 c.c. of a solution of caustic soda made by dissolving 1 pound of "pure by alcohol" caustic soda in 1 litre of water.) One hundred and forty-five c.c. of boiling water (measured hot) are then carefully added drop by drop to avoid loss by spurting, and finally 10 c.c. of a 10 per cent. (by volume) solution of sulphuric acid, when the flask is corked and thoroughly shaken. The contents of the flask are cooled by immersing the flask in cold water until the fatty acids have set to a compact cake; the liquid is then filtered. Twenty c.c. of boiling water are added to the fatty acids which are retained in the flask, the acids melted, and again cooled. The liquid is poured through the same filter as before, and the cake of fatty acids broken by shaking violently against the sides of the flask, and then transferred to the filter-paper by successive quantities of 20 c.c. and 10 c.c. of cold water. The filter-paper is allowed to drain and then removed from the funnel, it being supported in the rim of the filter-stand. The flask is inverted almost, but not quite, vertically over the filter-paper, and the whole is allowed to drain overnight. In the morning the flask is heated in the water-oven for about five minutes, and a current of air is blown through, the filter-paper being then added and the drying continued for a further ten minutes. One hundred c.c. of alcohol (industrial methylated spirit), sp. gr. 0·920 at 15·5° C., are next added from a carefully graduated pipette, the flask corked, and the alcohol heated until the fatty acids have completely dissolved. The alcohol is then cooled below 15·5° C., thoroughly shaken, and allowed to stand in water at 15·5° C. for half an hour or until its temperature is exactly 15·5° C. It is then filtered, and 50 c.c. of the filtrate titrated with $\frac{N}{10}$ caustic soda after the addition of 1 c.c. of 0·2 per cent. phenolphthaleïn solution. In the case of fats containing large quantities of coconut oil the end-point is rather vague, and a little practice is necessary before it can be judged exactly. No water should be added.

### The Estimation of Coconut Oil in Mixtures.

(*a*) *Mixtures of Oleo-Margarine and Coconut Oil.*—A number of mixtures has been made containing coconut oil and oleo-margarine in varying proportions, and the modified Shrewsbury and Knapp process has been carried out on these. The results are given in Table II. The oleo-margarine was made by mixing equal weights of *premier jus* and lard. Since making this mixture it has been found that the sample of lard used gives results which are rather above the average, but, as is considered below, this is easily allowed for.

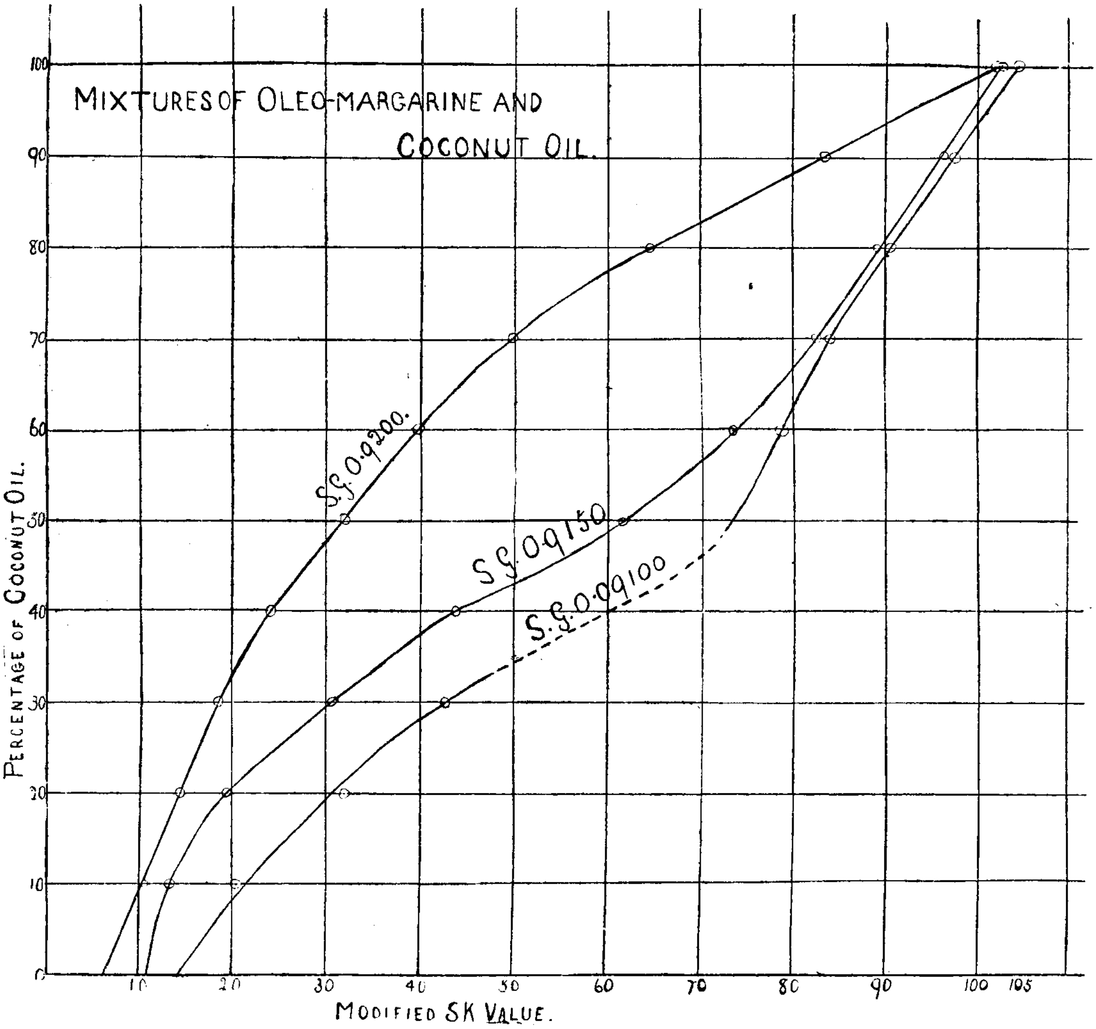
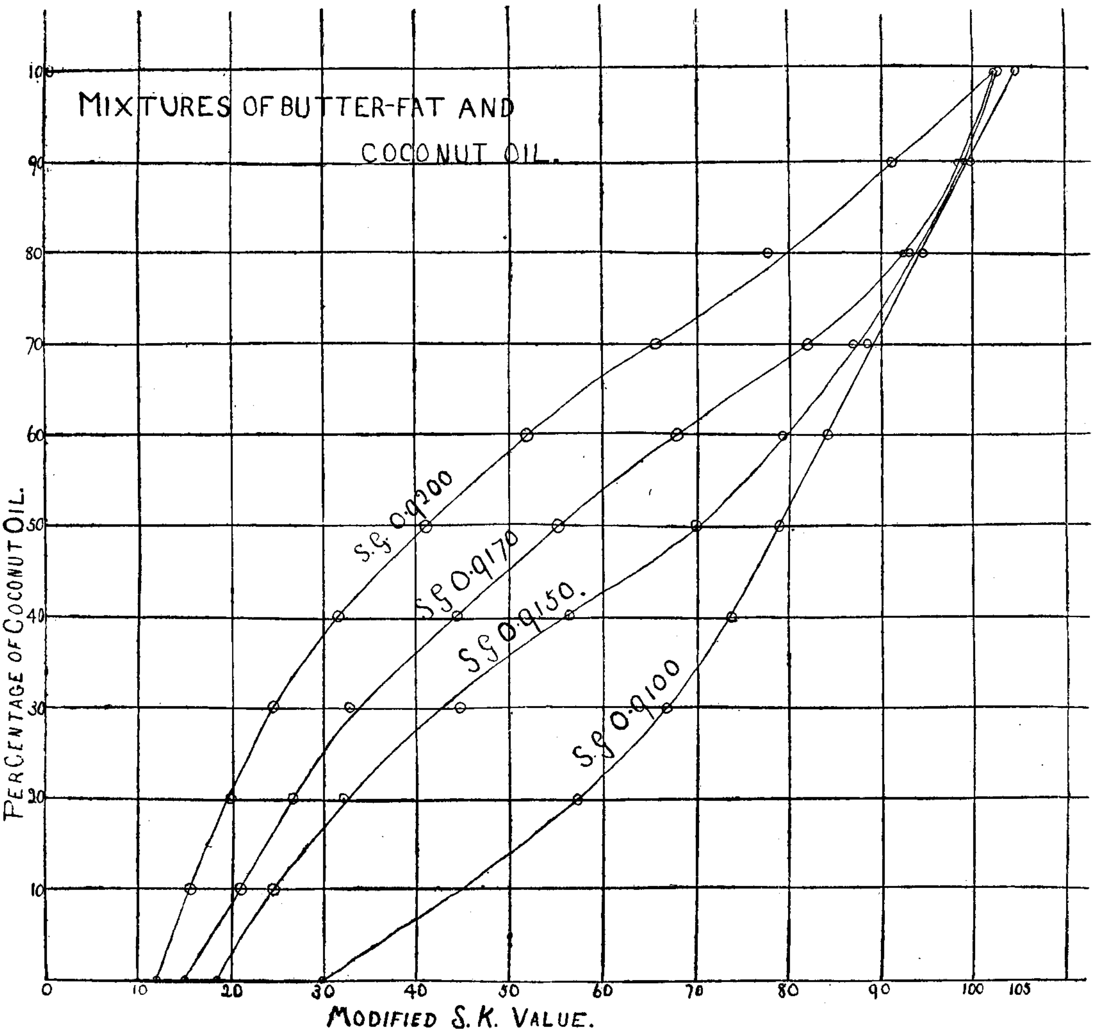


TABLE II.—MIXTURES OF OLEO-MARGARINE AND COCONUT OIL.

| Percentage of Coconut Oil | | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sp. Gr. of Alcohol at 15·5° C. | 0·905 | 25·0 | 25·3 | 38·7 | — | — | — | — | — | — | — | 105·4 |
| | 0·910 | 14·2 | 20·5 | 32·2 | 42·7 | — | — | 78·8 | 84·2 | 90·5 | 97·4 | 104·3 |
| | 0·915 | 10·8 | 13·3 | 19·5 | 30·7 | 43·8 | 61·9 | 73·5 | 82·7 | 89·1 | 96·4 | 102·4 |
| | 0·920 | 6·2 | 10·6 | 14·4 | 18·6 | 24·1 | 32·2 | 39·9 | 49·9 | 64·6 | 83·5 | 102·0 |



When these results are plotted in the form of a curve, as is shown in the figure on p. 76, it will be seen that the figures for those mixtures containing the lower amounts of coconut oil lie practically on a straight line. From this curve, knowing the Shrewsbury and Knapp value of a fat, it is possible to read off the percentage of coconut oil present. The curve is, of course, only strictly applicable to a particular sample of oleo-margarine and a particular sample of coconut oil, and the figures thus obtained will be more or less inaccurate according as the figures for the original oils are near or far away from the average; the process is, however, no worse off in this direction than any other process. As far as coconut oil is concerned, various samples appear to give uniform results; thus, six samples examined by the authors have given results varying from 101·6 to 103·6. In connection with the oleo-margarine, as has been already mentioned, the sample used by the authors is somewhat higher than that found for commercial samples of non-coconut margarine. Eight samples of such margarine have given results varying from 3·8 to 4·7, and therefore 4·0, as the average found, seems to be a suitable figure to take. The curve, then, will have to be corrected for this difference in the base used. From the figures given for mixtures of coconut oil, oleo-margarine, and butter, it will be seen that the *shape* of the curve is not altered, at any rate for the smaller percentage of coconut oil, by small differences in the composition of the non-coconut basis; we can thus get a curve, parallel to the curve obtained by plotting the figures given in Table II., from which we can read the percentage of coconut oil in commercial margarine.

(*b*) *Mixtures of Butter and Coconut Oil.*—In the same manner, a number of mixtures have been made of butter and coconut oil, and the Shrewsbury and Knapp process carried out on these. The coconut oil used was the same sample that was used for the mixtures with oleo-margarine; the butter used was a mixture of a large number of commercial samples all of which had given normal figures. The figures obtained are given in Table III., and they have also been arranged in the form of a curve (see p. 77).

TABLE III.—MIXTURES OF BUTTER AND COCONUT OIL.

| Percentage of Coconut Oil | | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sp. Gr. of Alcohol at 15·5° C. | 0·910 | 29·8 | 42·4 | 57·3 | 67·0 | 74·0 | 79·0 | 84·2 | 88·5 | 94·3 | 99·5 | 104·3 |
| | 0·915 | 18·4 | 24·6 | 32·3 | 44·8 | 56·5 | 70·1 | 79·5 | 87·0 | 93·0 | 98·8 | 102·4 |
| | 0·917 | 15·0 | 21·0 | 26·8 | 33·0 | 44·5 | 55·3 | 68·0 | 76·5 | 92·3 | 98·5 | 102·0 |
| | 0·920 | 12·0 | 15·6 | 19·8 | 24·7 | 31·7 | 41·0 | 52·0 | 65·8 | 77·7 | 91·0 | 102·0 |

The same remarks apply to these figures as to the figures given for the mixtures of oleo-margarine and coconut oil. Figures are given below showing the range, so far as found, for samples of pure butter.

(*c*) *Mixtures of Butter, Oleo-Margarine, and Coconut Oil.*—As has been mentioned above, Revis and Bolton, in their paper, give the results that they have obtained on mixtures of butter, margarine, and coconut oil by their modification; the authors have to confess, however, that they are unable to understand Table III. as given by them. In the first place they give, as the figure for a mixture containing 75 per cent. of coconut oil, 190·6, whilst the highest possible figure that can be given by a *pure* coconut oil, assuming all the acids to be soluble in the alcohol used, is about 107; it is possible, however, that their figures are obtained by doubling the actual figures found by titration. In the second place the figures given by mixtures of oleo-margarine and coconut oil fluctuate in a serious manner with small additions of butter fat; thus, the figure for a mixture of 25 per cent. of coconut oil and 75 per cent. of oleo-margarine is increased from 39·6 to 64·0 by the addition of 2 per cent. of butter fat; a further 3 per cent. of butter fat reduces the figure to 44·6, whilst a further addition of 5 per cent. of butter fat increases the figure once again to 60·8. Similar results are given with the mixtures containing 50 per cent. of coconut oil. From these figures one can only deduce one of two things: either that the process as described does not give sufficiently concordant results, or that the process is useless for such mixtures—the mixtures which are, after all, those for which it should be most useful. In order to test this matter, various mixtures have been examined by the proposed new process, with, as will be seen, very different results. These results are given in Table IV.

Table IV.—Mixtures of Butter, Oleo-Margarine, and Coconut Oil, Alcohol Sp. Gr. 0·920 at 15·5° C.

| Percentage of Coconut Oil | Percentage of Butter Fat. | | | | |
|---|---|---|---|---|---|
| | 0·0 | 2·5 | 5·0 | 10·0 | 20·0 |
| 0·0 | 6·2 | 6·2 | 6·3 | 6·6 | 6·9 |
| 5·0 | 7·6 | 7·6 | 7·8 | 8·0 | 8·2 |
| 10·0 | 10·6 | 10·6 | 10·7 | 10·8 | 11·0 |
| 20·0 | 14·4 | 14·0 | 14·3 | 14·8 | 15·0 |
| 40·0 | 24·1 | 24·2 | 24·3 | 24·7 | 25·8 |
| 60·0 | 39·9 | 40·4 | 40·8 | 41·8 | 42·5 |
| 70·0 | 49·9 | 50·6 | 52·4 | 55·3 | 59·6 |

From these figures it will be seen that the results are practically unaltered by small additions of butter fat, which is, of course, what would be expected. In the case of mixtures, therefore, in calculating the percentage of coconut oil, the presence of any amount of butter fat up to 10 per cent. (the limit for margarines) may be almost disregarded. In the case of mixtures containing large quantities of butter-fat a small correction could easily be made. As has been stated above, the process does not give very concordant results with mixtures containing much more than 60 per cent. of coconut oil if alcohol of sp. gr. 0·920 is used; for this reason the results for the mixtures containing more coconut oil than this are given for alcohol sp. gr. 0·910 in Table V.

TABLE V.—MIXTURES OF BUTTER, OLEO-MARGARINE, AND COCONUT OIL, ALCOHOL SP. GR. 0·910 AT 15·5° C.

| | Percentage of Butter Fat. | | | | |
|---|---|---|---|---|---|
| Percentage of Coconut Oil | 0·0 | 2·5 | 5·0 | 10·0 | 20·0 |
| 60 | 78·8 | 78·8 | 79·0 | 79·2 | 80·3 |
| 70 | 84·2 | 84·2 | 84·2 | 84·8 | 85·8 |
| 80 | 90·5 | 90·5 | 90·6 | 91·8 | 94·3 |
| 90 | 97·4 | 97·3 | 97·9 | 99·5 | — |

From these tables, knowing the Shrewsbury and Knapp figures and the approximate percentage of butter from the Reichert-Polenske-Kirschner process, the amount of coconut oil present is easily calculated.

*The Figures for Pure Butter.*—Fourteen samples of butter have been examined by the proposed process, and figures have been obtained varying from 9·0 to 13·0, the average being 11·0. For the present this latter figure would seem the best one to be taken in calculating the percentage of coconut oil in mixtures of butter and coconut oil, coconut oil being considered to be present when the figure is over 14·0.

It is hoped that the calculation of the percentage of butter and coconut oil present together in mixtures, and a proposed method for differentiating between coconut oil and palm kernel oil, may be dealt with more fully in a paper shortly to be published.

Preliminary experiments have been made with a view to combining the Shrewsbury and Knapp process with the Reichert-Polenske-Kirschner process. These experiments have been very successful, and it is hoped that the matter may be fully dealt with on a future occasion.

MUNICIPAL LABORATORY,
SALFORD.

## DISCUSSION.

Mr. A. W. KNAPP said that it had been somewhat of a disappointment to Mr. Shrewsbury and himself that experienced workers had thought it necessary to modify the process, indicating that they had failed to get concordant results with the original process, because he and Mr. Shrewsbury had succeeded very well. It was evident that at the outset the original process presented certain difficulties, and he thought that with Messrs. Elsdon and Bagshawe's modification workers might hope to be not so long in learning to get good results; but at the same time it must be pointed out that the modified process was much slower than the original process, in which speed was particularly aimed at. In the course of their investigations they practically passed through the modification proposed by Messrs. Elsdon and Bagshawe, having adopted it to begin with as the most natural method; and it might therefore be interesting to look at the reasons which led them to abandon it. In the first place, the question of the strength of the alcohol was worked out very carefully, the sp. gr. of the alcohol used being ·922, as against ·920 in the proposed modification. An earlier investigator, Robin, preferred ·921 for dissolving the fatty acids of coconut oil. Vandam used a rather stronger spirit. The strength which they recommended was arrived at as follows:

TABLE I.—SOLUBILITY OF THE FATTY ACIDS AT 25° C.

| To 50 c.c. Alcohol (·822) Added Water. | Sp. Gr. of Alcohol and Water Mixture. | Volume. | C.c. $\frac{N}{10}$ NaOH for Soluble Fatty Acids from 5 Grms. of Fat. | |
|---|---|---|---|---|
| | | | Butter. | Coconut Oil. |
| 36 c.c. | ·922 | 83·7 c.c. | 23·0 | 216·5 |
| 41 c.c. | ·929 | 88·5 c.c. | 16·0 | 190·0 |
| 51 c.c. | ·939 | 98·2 c.c. | 11·5 | 173·5 |

TABLE II.—SOLUBILITY IN ALCOHOL (SP. GR. ·922)—EFFECT OF TEMPERATURE.

| Temperature. | C.c. $\frac{N}{10}$ NaOH for Soluble Fatty Acids from 5 Grms. of Fat. | | | |
|---|---|---|---|---|
| | Butter. | Coconut Oil. | Margarine. | Butter with 20 per Cent. Coconut Oil. |
| 9·5° C. | 19 | 169 | 12 | 28 |
| 14° C. | 22 | 208 | 11 | 31 |
| 25° C. | 23 | 212 | 14 | 31 |

Starting with the ordinary Reichert-Meissl process, and working on coconut oil, the fatty acids obtained from the 5 grms. taken were dissolved in 50 c.c. of alcohol (industrial methylated spirit, sp. gr. ·822), water being then added drop by drop until the liquid became just turbid, the idea being to find a strength of alcohol capable of holding in solution the whole of the coconut oil fatty acids that might be present. They had thought at one time that possibly a simple method of detecting coconut oil might be arrived at in that way—namely, by preparing the fatty acids from the sample, dissolving them in 50 c.c. of alcohol, and noting how much water was required just to produce turbidity. The amount of water required for coconut oil was very constant, being always about 36 to 38 c.c., but for butter it was unfortunately very irregular, varying from 7 to 24 c.c. That, however, was how the 36 c.c. of water used in the process was arrived at, giving an alcohol with a sp. gr. of ·922, and this was the strength which they had found to give the widest range between coconut oil and butter. In their earlier experiments they worked similarly to the present authors, but only allowed ten minutes' standing; but on making experiments with pure glycerides, they found that there was, at ordinary temperatures, a tendency to form supersaturated solutions. The question was one of differential solubility, and they found that, at temperatures below 14° C., the solubility of the fatty acids of coconut oil rapidly decreased, whereas above 14° it increased only very slightly. A higher temperature was therefore tried, and as a result the fatty acids were obtained in a liquid state, so that, while those undissolved floated to the top, the liquid containing the dissolved coconut oil fatty acids could be run off from below. They had always recognised that the whole of the fatty acids did not rise in the three minutes, but it was found that when a longer time was allowed (say thirty minutes) the difference between the figures for coconut oil and for butter was decreased. In Messrs. Elsdon and Bagshawe's process he thought it important that the temperature should not be allowed to fall below 15·5° C. For large quantities of coconut oil the process did not even yet seem to be satisfactory, but he gathered that decinormal solutions were used for titration, which would involve the addition of a large quantity of water to the alcoholic solution, and thus spoil the end reaction. Better results would probably be obtained if in titrating one either added more alcohol or, which would be preferable, used normal alkali for titration.

Mr. C. REVIS said that if Messrs. Elsdon and Bagshawe had done nothing more, they would have done good service to anyone who had to deal with fractional crystallisation of fatty acids from alcoholic solutions, in showing how greatly the results were affected by the strength of the alcohol, and how difficult it was to escape from the effects of supersaturation. This had also been shown in some recently published American work in connection with Hehner and Mitchell's method of estimating stearic acid. Although the authors had obtained excellent results from the scientific point of view, he feared that from the practical laboratory point of view the process stood condemned on the very tables given in the paper. From the large differences caused by comparatively small variations in the strength of the alcohol, it was evident that the necessary delicacy of manipulation could not be maintained under ordinary conditions. Mr. Bolton and he did not intend to throw any aspersion on the original process; it was not uncommon for a process satisfactory in the hands of its author to be wrongly interpreted by other workers. When Mr. Bolton and he started to investigate this subject, they were under the urgent necessity of finding a quick and accurate way of arriving at the composition of these coconut oil mixtures, which then were just coming into use, and they thought it well to begin by examining existing processes rather than to devise a new one. They found that the standard process which everyone used—the Reichert-Meissl-Polenske process—was capable of doing what was needed as accurately and as well as any other method when carried out in a standard way, and, since the figures obtained by Messrs. Shrewsbury and Knapp's process appeared to them to give less reliable information than that given by the standard process, it did not seem worth while to investigate it further.

Mr. KNAPP said that at the time when he and Mr. Shrewsbury devised their process the Polenske method was not fully appreciated, and he agreed that, provided the coconut oil was not specially prepared, the Polenske process was sufficient for the purpose. It was possible, however, so to prepare coconut oil products that the amount present would not be disclosed by the Polenske process, and it was then that a process depending on alcohol solubility became useful, since it depended, not on the volatile fatty acids, but on the main bulk (60 per cent. or so) of the coconut oil itself. As an example, the figures on a butter containing 20 per cent. of a commercial coconut " stearine " are of interest.

| | Reichert-Meissl. | Polenske. | Kirschner. | Shrewsbury and Knapp. |
|---|---|---|---|---|
| Butter A .. .. .. .. | 29·5 | 2·9 | 21·5 | 32·6 |
| Coconut stearine .. .. .. | 3·6 | 7·2 | 0·3 | 163·5 |
| Butter fat A with 20 per cent. coconut stearine .. .. .. | 24·4 | 4·0 | 17·2 | 40·3 |

It will be seen that the Polenske process indicates the presence of only 10 per cent. of coconut oil, whilst the Kirschner indicates the absence of about 20 per cent. of butter, and the Shrewsbury-Knapp process the presence of 17 per cent. of a coconut oil product.

In order to test the relative difficulty of obtaining duplicates when first trying the process, Mr. R. V. Wadsworth, who had never performed either process, tried both the Polenske and our process. On the same butter he obtained the following results in the order given. Polenske figure: 2·6, 2·9, 2·9, 3·0; Shrewsbury-Knapp figure: 34·5, 32·3, 31·5, 32·3. It may be pointed out that for calculation purposes an error of 0·1 c.c. in the Polenske is equivalent to 0·8 to 1·0 c.c. in our process.

Mr. Bolton thought that, provided the coconut oil was satisfactory as regards taste and absence of free fatty acid, the manufacturer would be content, and would not trouble much whether its presence could be detected or not. Moreover, manufacturers of coconut oil usually dealt also with palm-kernel oil, and the two often got mixed. A process for the detection of palm-kernel oil had been devised by Burnett and Revis (Analyst, 1913, **38**, 255). When palm-kernel oil, and also other lesser known oils of the palm-kernel family, happened to occur in margarine, abnormal figures would be obtained, but that did not mean that the coconut oil had been specially prepared, having a composition calculated to defeat analytical tests.

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# THE QUANTITATIVE ESTIMATION OF MERCURY IN ORGANIC COMPOUNDS.

By J. E. MARSH, M.A., F.R.S., and O. G. LYE.

(*Read at the Meeting, March* 7, 1917.)

The process here described is a modification of the method of estimating mercury by combustion with quick-lime. When organic mercury compounds, especially aromatic derivatives, are analysed by the ordinary lime-combustion method, there occurs frequently, besides a deposit of carbon on the lime, a distillate of tarry or crystalline substances. These mix with the mercury and make it difficult to purify. We have found that the mercury derivatives of aromatic sulphonic acids, analysed in this way, gave no condensable distillate other than mercury. The lime, for the most part, remains uncoloured, and calcium sulphide is formed by the reduction of the sulphonic group. We have also found that for mercury organic compounds other than sulphonic acids it is only necessary to mix the substance with a sulphate such as calcium sulphate and with quick-lime to obtain a very good result, the mercury being collected in a single globule without any tarry or crystalline distillate. The process then consists in distilling the mercury compound mixed with about twice its weight of dry calcium sulphate and with excess of quick-lime in the ordinary way. To expel the mercury vapour left in the tube at the end of the combustion we have found it best to use carbon monoxide evolved from calcium oxalate which is placed at the closed end of the combustion tube. With one combustion furnace two analyses can be carried out at the same time, one at each end of the furnace, and finished in less than an hour.

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# ABSTRACTS OF PAPERS PUBLISHED IN OTHER JOURNALS.

## FOOD AND DRUGS ANALYSIS.

**Estimation of Theobromine and Caffeine in Cocoa and Chocolate. G. Savini.** (*Annali Chim. Applic.*, 1916, **6**, 247-250.)—Complete extraction of the fat from cocoa with a solvent causes more or less loss of the alkaloids. For example, on extracting the fat from 10 grms. of cocoa with petroleum spirit from 0·002 to 0·004 grm. of the alkaloids was decomposed, whilst when carbon tetrachloride was used the amount of caffeine decomposed varied from 0·004 to 0·008 grm. In the following method this loss is obviated: 12 grms. of the finely powdered cocoa or chocolate are heated on the water-bath for ten minutes with 70 c.c. of petroleum spirit in a 500 c.c. flask, the extract decanted through a filter, and the process repeated twice. The filter-paper is returned to the flask, which is then heated for a few minutes in the water-oven to expel the solvent, and the residue is boiled for an hour beneath a reflux condenser with 5 c.c. of 10 per cent. sulphuric acid and about 250 c.c. of water. The hot liquid is poured off, the residue washed with hot water, and the solution and washings cooled to about 30° C., made up to 300 c.c., and filtered; 250 c.c. of the filtrate (= 10 grms. of the sample) are mixed with 10 grms. of fine sand and sufficient magnesia to make the mass alkaline, and evaporated to a syrup, which is then mixed with 8 to 10 grms. more of magnesia so as to convert it into a dry powder. This is transferred to a flask and treated with 100 c.c. of chloroform, the basin and spatula being rinsed twice with 2·5 c.c. of hot water, which is added to the chloroform in the flask. An addition of 0·25 c.c. of strong ammonia solution is then made, the liquid boiled for fifteen minutes beneath a reflux condenser, and decanted through a filter, and the residue again extracted, this time with 100 c.c. of chloroform only. This process is repeated three times more, so that, in all, 500 c.c. of chloroform have been used. The united extracts are evaporated to dryness on the water-bath, and the residue washed twice with 5 c.c., each time, of petroleum spirit, the washings being decanted through a small filter. Finally the residue is taken up in a little boiling water, the solution filtered through the same filter, the insoluble residue washed three times with boiling water, the filtrate and washings evaporated, and the residue of theobromine and caffeine dried for an hour at 100° C. and weighed. C. A. M.

**Detection of Arachis Oil in Olive Oil. R. Biazzo and S. Vigdorcik.** (*Annali Chim. Applic.*, 1916, **6**, 179-185.)—Twenty grms. of the oil are heated on a sand-bath with 40 c.c. of alcoholic potassium hydroxide (40 c.c. of 50 per cent. aqueous potassium hydroxide solution mixed with 100 c.c. of 96 per cent. alcohol and filtered through glass wool) until the liquid is homogeneous. It is then boiled for five minutes, the soap dissolved in 150 c.c. of water, and the fatty acids liberated by the addition of dilute sulphuric acid, and extracted with 200 c.c. of ether. The ethereal solution is washed twice with 150 c.c. of water, and then shaken for five minutes with 50 c.c. of a 30 per cent. solution of normal lead acetate. The lead salts of the liquid fatty acids remain dissolved in the ether, whilst those of the solid fatty acids separate out at the zone of contact of the ether and the aqueous layer. In the case of obstinate emulsions the particles of insoluble lead soaps are separated by filtering the aqueous layer, and are returned to the separating funnel. After separation of the aqueous layer the clear ethereal solution is decanted through a dry filter, and the insoluble lead soaps are shaken for thirty minutes with 75 c.c. of ether at 15° C., and are then transferred to the filter and again washed with ether. They are then shaken in a separating funnel with 200 c.c. of ether and two successive portions of 100 c.c. of 20 per cent. hydrochloric acid, the ethereal layer containing the liberated fatty acids is washed with water, dried with calcium chloride, filtered and evaporated, and the residue of solid fatty acids tested for arachidic and lignoceric acids. For this purpose the following modification of the method of Kreis and Roth (ANALYST, 1913, **38**, 160) is recommended: The solid fatty acids are dissolved in 50 c.c. of 90 per cent. alcohol (containing 10 drops of $\frac{N}{1}$-hydrochloric acid per litre), the flask immersed in water at 15° C. for thirty minutes, and the crystals which separate dissolved in 25 c.c. of alcohol, which is cooled as before. If crystals are still obtained they are dissolved in 12·5 c.c. of alcohol, the solution again cooled, and any further crystals are dissolved in 5 c.c. of alcohol, which is then allowed to stand at the ordinary temperature. By this means it is possible to separate from olive oil containing 5 per cent. of arachis oil a sufficient quantity of crystals for the determination of the melting-point, which will be about 73·5° to 74° C. For the estimation of arachis oil the method of Tortelli and Ruggeri (ANALYST, 1898, **23**, 273) gives trustworthy results. The arachis oil used in the experiments contained 4·65 per cent. of arachidic and lignoceric acids. C. A. M.

**Detection of Rape Oil in Olive Oil. R. Biazzo and S. Vigdorcik.** (*Annali Chim. Applic.*, 1916, **6**, 185-195.)—Twenty grms. of the oil are saponified as described in the preceding abstract, the fatty acids extracted with ether and sulphuric acid, the ethereal extract washed free from mineral acid, dried with calcium chloride and distilled, and the residue dried for fifteen minutes in the water-oven. The fatty acids are dissolved in 180 c.c. of anhydrous acetone, and the solution heated to incipient boiling, treated with 20 c.c. of N-potassium hydroxide solution, and cooled at 15° C. The precipitated soaps are separated with the aid of a pump, washed four times with successive portions of 10 c.c. of cold acetone, and dissolved in water, and the solid fatty acids liberated by treatment with hydrochloric acid and 100 c.c. of ether. The ethereal solution is washed twice with 100 c.c. of water each time, and shaken for five minutes with 15 c.c. of a 30 per cent. aqueous solution of lead acetate, and the insoluble lead soaps tested for arachidic and lignoceric acids (presence of arachis oil) as described in the preceding abstract. The ethereal solution, which will contain the lead salts of the liquid fatty acids and of erucic acid if rape oil be present, is washed free from mineral acid, and hydrogenated in the presence of finely divided palladium. The ether is then distilled, and the hydrogenated fatty acids are fractionally crystallised by a modification of the method of Kreis and Roth (see preceding abstract). If the last fraction melts above 71° C., the presence of behenic acid, produced by the hydrogenation of erucic acid, is indicated. As a rule, in the case of oils containing rape oil the melting-point of the crystals finally obtained is from 76° C. and upwards. Hydrogenation of erucic acid in ethereal solution yielded behenic acid melting at 78·5° C., and, after three recrystallisations from alcohol, at 82° C. Behenic acid is also characterised by its sparing solubility in 90 per cent. alcohol. C. A. M.

**Estimation of Sugars in the Presence of Gum. G. Savini.** (*Annali Chim. Applic.*, 1916, **6**, 250-255.)—In the ordinary official methods of estimating sugars in gum pastilles, etc., the aqueous solution is treated with basic lead acetate, the excess of lead being afterwards removed by precipitation with sodium sulphate, phosphate or carbonate. Owing to the fact that gum arabic is not completely precipitated by basic lead acetate, the amounts of sugar estimated in the filtrate are inaccurate, the variations in the error depending upon whether the gum arabic was dextro- or lævo-rotatory. Better results are obtained by using a mixture of basic lead acetate and alcohol to separate the gum, as was first suggested by Chauvin. Twenty grms.

of the substance under examination are dissolved in about 110 c.c. of hot water, and the solution cooled and treated with a mixture of 10 c.c. of basic lead acetate solution and 70 c.c. of 95 per cent. alcohol, which is added little by little with constant agitation. After standing for about an hour the liquid is diluted to 200 c.c., allowance being made for the volume of the precipitate, and is then filtered. An aliquot part (100 c.c.) of the filtrate is neutralised with a few drops of acetic acid, rapidly evaporated on the water-bath to expel the greater part of the alcohol, the residual liquid diluted to 100 c.c., and after the addition of a small quantity of alum to remove the excess of lead, it is again made up to 200 c.c. and filtered. The sugars in the filtrate are then estimated by the usual methods. The results given in detail show that the presence of gum arabic does not affect the accuracy of the estimation of cane sugar or dextrose, but that in the case of products containing invert sugar gum arabic has a certain influence upon the optical rotation, although even then the method is more accurate than the ordinary method. C. A. M.

## BACTERIOLOGICAL, PHYSIOLOGICAL, ETC.

**The Identification and Estimation of Lactic Acid in Biological Products. —I. I. K. Phelps and H. E. Palmer.** (*J. Amer. Chem. Soc.*, 1917, **39**, 136-149.)—It is shown that lactic acid may be estimated as guanidine lactate, identified by its melting-point, 160° C., after separation by esterification from citric and tartaric acids and by fractional distillation from formic and acetic acids. Lactic acid may be separated from mixtures containing formic, acetic, propionic, butyric, and citric acids, and accurately estimated by weighing as quinine lactate, which is identified by its melting-point, 165° to 166·5° C. (racemic). The separation from citric acid and other acids whose ethyl esters have high boiling-points is effected by esterification with the vapour of alcohol containing dry hydrogen chloride in solution passed through the mixture suspended in vaseline at 100° to 110° C., using zinc chloride as a second catalyser; the ethyl lactate passes quantitatively into the distillate, while the ethyl citrate remains in the flask. By fractional distillation of the distillate through a Hempel fractionating column filled with glass beads the ethyl formate and acetate, together with a large part of the propionate and butyrate, are removed. The residue in the flask containing the ethyl lactate is hydrolysed and converted into quinine salts, and the quinine lactate separated from the propionate and butyrate by the solubility of the latter in carbon tetrachloride. Esterification of mixtures containing lactic acid is effected in a distillation flask of 75 c.c. capacity, with side-neck connected with a condenser. This is charged with the lactic acid mixture, 1 grm. of zinc chloride, 25 c.c. of vaseline, and 10 c.c. of absolute alcohol containing in solution 2·5 grms. of hydrogen chloride per litre. It is kept at 100° to 110° C. by a glycerol bath, and 190 c.c. of similar acid and alcohol are distilled through the mixture from another flask, connected with the esterification flask, during a period of one and a half hours. The distillate of esters is fractionated through a 15 cm. Hempel column until the volume of residue is 20 c.c.; 100 c.c. of alcohol are added and distillation continued; this is again repeated. The beads in the column are washed with alcohol, and the distillation residue treated with excess of silver carbonate, allowed to stand two hours in the dark, and filtered through asbestos. An excess of barium hydroxide is added to the filtrate, which is heated on the water-bath for one hour until the ethyl lactate is completely hydrolysed. The excess of barium hydroxide is precipitated by a current of carbon dioxide, the solution evaporated to dryness, and the residue extracted with 25 c.c. of water and filtered through asbestos. To the filtrate is added a slight excess of a neutral solution of quinine sulphate, calculated from the barium hydroxide used, and the precipitated barium sulphate is removed by filtration as soon as possible after cooling in ice. The filtrate contains quinine lactate and any excess of quinine sulphate; it is rinsed with 95 per cent. alcohol into a distilling flask and evaporated to dryness under diminished pressure, so as to keep the temperature as low as possible. After distillation is complete the walls of the flask are washed down with 10 c.c. of alcohol, and the latter again removed by distillation under diminished pressure. This treatment frees the residue as far as possible from moisture, and brings it into a condition suitable for carbon tetrachloride extraction. The residue is warmed with 50 c.c. of the tetrachloride to remove the quinine propionate and butyrate; the amount of solvent necessary for this depends on the quantity of these salts, as determined by their solubilities in comparison with that of quinine lactate, and the loss of lactic acid increases with the proportions of propionate and butyrate present. The residue is filtered off after standing for eighteen hours, and washed with tetrachloride. The substance on the filter and in the flask, after evaporating the tetrachloride, is treated for one hour with chloroform free from alcohol, which dissolves the quinine lactate, leaving the quinine sulphate. The solution is filtered, the filtrate together with the washings evaporated, and the residue dried under diminished pressure at 75° C. and weighed. The lactate may be further purified, if necessary, by redissolving in hot ethyl acetate free from alcohol. The evaporation of aqueous solutions of quinine lactate must be conducted at temperatures as low as possible, to avoid the formation of quinotoxine lactate, which is far more soluble in carbon tetrachloride. The estimation of lactic acid as guanidine lactate is carried out by esterification on similar lines, but is only admissible when the ethyl esters can be thoroughly separated by fractional distillation—*e.g.*, ethyl formate and ethyl acetate. The barium lactate solution is treated with slight excess of guanidine sulphate; the barium sulphate is filtered off and washed with water; the solution is evaporated to dryness in an Erlenmeyer flask, and all moisture removed by a current of air. The residue is digested for eighteen hours with 50 c.c. of absolute alcohol in which the guanidine lactate is readily soluble and the sulphate only sparingly. A second extraction is made to insure completeness, and the combined filtrates evaporated, the residue dried under diminished pressure at 50° C., and weighed. J. F. B.

**Pyrrole Black. A. Angeli.** (*Gazz. Chim. Ital.*, 1916, **46**, 279-282; 283-300.)—On treating a solution of pyrrole in acetic acid, chilled with ice, with hydrogen peroxide it is oxidised, and yields a crystalline derivative which agrees in composition and properties with succinimide and an amorphous black powder, for which the name of *pyrrole black* is suggested. It has a composition closely resembling that of the melanins of animal pigments (carbon, 60·01 to 58·14; hydrogen, 4·87 to 4·31;

and nitrogen, 15·81 to 15·27 per cent.), and also resembles them in being soluble in solutions of alkalis and ammonia. It does not dissolve in the ordinary organic solvents, but is sparingly soluble in pyridin. C. A. M.

**Urinary Test for Trinitrotoluene (T.N.T.): Illness and the Early Diagnosis of Cases suffering from Trinitrotoluene Absorption. B. Moore.** (*Medical Press*, 1916, 537.)—Trinitrotoluene, like some other toxic substances, becomes bound up in the body in a probably less poisonous form in which it is no longer soluble in the usual solvents, requiring to be set free again before it can be recognised by chemical tests. In such cases it is not obtainable from urine by ether extraction, unless previously acidified. If a positive reaction is obtained without acidification, it may be set down to contamination from clothing, skin, or hair, in the act of passing the urine, and is an indication that proper precautions are not being observed. When patients show a positive reaction they should discontinue work for some days, when, as a rule, the urine becomes normal; if it does not and the symptoms continue, they are specially susceptible, and should not be allowed to proceed with this class of work at all. A method is given for testing urine for trinitrotoluene as described by Webster, in which 12·5 c.c. of the urine are mixed with the same volume of 20 per cent. sulphuric acid, and then extracted in a separating funnel with ether. The ethereal extract, after washing with water, is tested for trinitrotoluene by adding 5 per cent. alcoholic potash, a purple coloration, rapidly turning to brown, being a positive indication. H. F. E. H.

## ORGANIC ANALYSIS.

**Identification of Acids. E. E. Reid.** (*J. Amer. Chem. Soc.*, 1917, **39,** 124-136.)—A new series of crystalline derivatives available for the identification of organic acids is readily prepared by the action of *p*-nitrobenzyl bromide on the potassium or sodium salts of the acids. The *p*-nitrobenzyl esters so formed usually crystallise well from dilute alcohol, and a large number of them are solids of well-defined melting-points. The reagent, *p*-nitrobenzyl bromide, is best prepared by heating *p*-nitrotoluene for some hours in a sealed tube at 125° to 130° C. with half the calculated quantity of bromine; the tube is opened and the hydrobromic acid allowed to escape, the other half of the bromine is then added, and the tube resealed and again heated. The product is dissolved in hot alcohol and separates on cooling. The white solid is dissolved in the proportion of 1 grm. in 10 c.c. of boiling 95 per cent. alcohol, 5 c.c. of water are added to the boiling solution, with a trace of animal charcoal, and the hot solution is filtered quickly. The *p*-nitrobenzyl chloride crystallises in white needles, melting-point 99° C. The preparation of the nitrobenzyl esters of the organic acid must be carried out in a common solvent of the bromide and the salt of the acid, for which purpose a mixture of 2 volumes of 95 per cent. alcohol and 1 volume of water, generally described as 63 per cent. alcohol, is usually most suitable. A boiling mixture of 10 c.c. of alcohol and 5 c.c. of water readily dissolves 1 grm. of the nitrobenzyl bromide which remains in solution, provided it is kept hot; it contains sufficient water to dissolve 1 grm. of the sodium or potassium salt of almost any organic acid at the ordinary temperature, and will retain in solution the resulting sodium or potassium bromide even at 0° C. The reaction is carried out in a flask by boiling under a reflux condenser for one hour with monobasic acids or two hours with dibasic acids. In preparing the salt by the neutralisation of an acid, the solution should be left slightly acid, since a trace of alkali in excess would produce ethyl esters. Systematic recrystallisation of the products from diluted alcohol is carried out until a constant melting-point is obtained. The following well-characterised esters are described: Formate, m.-pt. 31° C.; acetate, m.-pt. 78° C.; propionate, m.-pt. 31° C.; butyrate, m.-pt. 35° C.; benzoate, m.-pt. 89° C.; *o*-toluate, m.-pt. 90·7° C.; *o*-nitrobenzoate, m.-pt. 111·8° C.; *o*-chlorobenzoate, m.-pt. 106° C.; anthranilate, m.-pt. 205° C.; *p*-bromobenzoate, m.-pt. 139·5° C.; 2, 4-dinitrobenzoate, m.-pt. 142° C.; phenylpropiolate, m.-pt. 83° C.; thiocyanate, m.-pt. 85° C.; oxalate, m.-pt. 204° C.; malonate, m.-pt. 85·5° C.; tartrate, m.-pt. 163° C.; citrate, m.-pt. 102° C. J. F. B.

**Influence of Carbohydrates on the Accuracy of the Van Slyke Method in the Hydrolysis of Casein. E. B. Hart and B. Sure.** (*J. Biol. Chem.*, 1916, **28,** 241-249; through *J. Soc. Chem. Ind.*, 1917, **36,** 158.)—The presence of carbohydrates during the hydrolysis of casein by the Van Slyke method brings about a total redistribution of the amino-acids, and this varies with the nature of the carbohydrate. The redistribution is particularly marked in the hexone bases, and a decided loss of amino-nitrogen also takes place when the protein is hydrolysed in the presence of xylan. The method of direct hydrolysis is, therefore, unreliable when applied to the determination of amino-acids in feeding stuffs; owing to the variation in the nature and quantity of the carbohydrates in feeding stuffs, it is impossible to establish factors of correction for the results.

**Use of Diphenylamine and Diphenylbenzidine for Colorimetric Estimation. L. Smith.** (*Zeitsch. anal. Chem.*, 1917, **56,** 28-42; through *J. Soc. Chem. Ind.*, 1917, **36,** 165.)—The intensity of the colour obtained with diphenylamine in the colorimetric estimation of nitric acid (compare Tillmanns, ANALYST, 1911, **36,** 67) is largely influenced by shaking the tube, excessive shaking causing a diminution. To obtain reliable results, therefore, shaking should be avoided, the necessary mixing being done by moving a suitable stirrer a few times up and down in the tube, and then allowing the liquid to remain at rest for the prescribed period of one hour. It is suggested that the observed phenomenon is due to the formation of a volatile substance during the oxidation of diphenylamine, the presence of hydrogen chloride being also a determining factor. The stability of the colour is at a maximum at ordinary temperatures. The sensitiveness of the reagent depends largely on its composition, and for the estimation of the following amounts of nitric anhydride per litre the annexed formulæ are recommended: 0·1-3·0 mgrms.; 0·04 grm. diphenylamine, 39 c.c. water, concentrated sulphuric acid to 100 c.c.; 0·5-10·0 mgrms.; 0·04 grm. diphenylamine, 26 c.c. water, and sulphuric acid to 100 c.c.; 1·0-25 mgrms.; 0·08 grm. diphenylamine, 20·5 c.c. water, and sulphuric acid to 100 c.c. Diphenylbenzidine behaves analogously to diphenylamine as a reagent for nitric acid, but its sensitiveness is somewhat greater.

**Importance of the Varrentrapp Reaction in Fats and Oils. W. Schrauth.** *Chem. Eng. and Manufacturer,* 1916, **24,** 203-204.)—Although hydrogenation in the presence of a catalyst is the usual modern method of converting unsaturated fatty acids into saturated ones, it seems possible that some of the older processes could be carried out on a commercial scale with the means now available. This applies especially to the Varrentrapp reaction, in which oleic acid is converted into palmitic acid by fusion with an excess of an alkali hydroxide: $C_{17}H_{33}COOH+2NaOH=C_{15}H_{31}COONa+CH_3COONa+H_2$. The reaction is not confined to oleic acid; all unsaturated acids may be converted into saturated acids of lower carbon content. The following are the details of the process as applied to whale oil: 2,500 kilos. of the whale oil fatty acids are placed in an autoclave of 5,000 litres capacity, 800 kilos. of sodium hydroxide dissolved in an equal quantity of water are added, and the mixture is heated at 260° C. for six hours. The pressure must not be allowed to exceed 10 atmospheres. The resulting mass, which is quite free from the objectionable odour of whale oil, may be worked up into a soap, or the fatty acids may be liberated and distilled. The yield of fatty acids so obtained is about 85 per cent. of the quantity taken originally. The hydrogen liberated during the reaction may be collected and utilised. W. P. S.

**Estimation of Free and Combined Sulphur in Vulcanised Rubber, and the Rate of Combination of Sulphur with Different Types of Plantation Para Rubber. B. J. Eaton and F. W. F. Day.** (*J. Soc. Chem. Ind.,* 1917, **36,** 16-20.)—The vulcanised rubber is crumbled between small creeping rollers, and a representative portion is selected and carefully picked over under a lens for "skin," insufficiently crumbled particles, etc.; 0·1374 grm. portions are then wrapped in filter-paper packets and extracted for about 100 hours with boiling acetone in a Beadle and Stevens apparatus (ANALYST, 1913, **38,** 143); three times during the extraction the packets being opened and their contents teased out. When the extraction is completed, the estimation of the sulphur by combustion is made as soon as possible. The packet is placed in a glass tube 3 cm. long and 1 cm. in diameter, sealed at one end; this is inserted in a combustion tube with the open end forward and about 8 cm. from the front end of the tube. This end of the tube is connected with two test-tubes, the first containing 1·5 c.c. and the second 0·2 c.c. of 7N sodium hydroxide solution; these tubes may also be connected with two small tubes containing 2N sodium hydroxide solution. Dry oxygen is passed through the apparatus while heat is applied, and as soon as the paper begins to char, the current is increased to about 400 c.c. per minute until ignition occurs. The current is then reduced, and regulated to produce a small bright flame with as little smoke as possible. The combustion takes about fifteen minutes. The contents of the absorption vessels are mixed, treated with bromine in hydrochloric acid, and the resulting sulphuric acid is precipitated as barium sulphate. The free or soluble sulphur is estimated in the acetone extract. The residue is heated with nitric acid and bromine under a reflux condenser, then evaporated to dryness, the residue heated with a mixture of fusion mixture, potassium nitrate, and potassium chlorate, the mass dissolved, the solution acidified, and the sulphuric acid precipitated with barium chloride.

Experiments with three different types of Para rubber showed that the rates at which they combined with sulphur was in accordance with their different rates of cure as estimated by their physical properties (load-stretch). The percentage of combined sulphur at the optimum time of cure was practically the same for all three types, and was always about 4 to 4·5 per cent. calculated on the mixing (90 per cent. rubber and 10 per cent. sulphur). W. P. S.

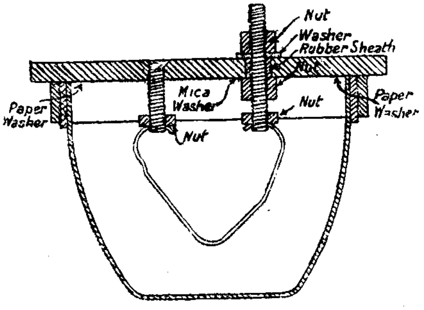
## INORGANIC ANALYSIS.

**Colorimetric Method for the Estimation of the Carbon Dioxide in Air. H. L. Higgins and W. M. Marriott.** (*J. Amer. Chem. Soc.*, 1917, **39**, 68-71.)—The method is based on the principle that when a current of air containing carbon dioxide is passed through a solution of sodium bicarbonate until the latter is saturated with carbon dioxide, the reaction of the saturated solution (hydrogen-ion concentration) will depend on the relative amounts of sodium bicarbonate and carbon dioxide present, and this will depend on the partial pressure of the carbon dioxide in the air-mixture used, regardless of the volume of air passed through, provided the saturation-point has been attained. The reaction of the solution is determined by adding to it a suitable indicator, such as phenolsulphonephthaleïn, on the principle of Sörensen's method, and comparing the result colorimetrically with solutions of known hydrogen-ion concentration. Standard solutions are prepared by mixing M/15 solutions of acid potassium phosphate ($KH_2PO_4$) and disodium hydrogen phosphate, both carefully purified by crystallisation, and the latter dehydrated to a stable condition corresponding to $Na_2HPO_4{\cdot}2H_2O$ by exposure to the air for several days. These solutions are each made up with 200 c.c. of 0·01 per cent. solution of phenolsulphonephthaleïn and diluted to 1 litre. A series of standard mixtures of these two solutions is prepared in sealed test-tubes, the proportions being determined empirically to correspond with definite percentages of carbon dioxide in air analysed by a chemical method. For applying the method, two standard bicarbonate solutions may conveniently be employed: A is $\frac{N}{1000}$, and is prepared by taking 10 c.c. of $\frac{N}{10}$ sodium hydroxide solution, adding 200 c.c. of phenolsulphonephthaleïn solution, and making up to 1 litre. B is for higher percentages, and is prepared similarly from 85 c.c. of $\frac{N}{10}$ sodium hydroxide. They are converted into bicarbonate by passing carbon dioxide through them from a cylinder. For the analysis, 2 to 3 c.c. of one of the bicarbonate solutions are placed in a test-tube of the same diameter as the standard tubes, but 100 to 150 mm. long. Air from the room is then blown in by means of an atomiser bulb and a glass tube drawn out to a fine point until the solution is saturated, when no further change in colour is observed. The test solution is then compared with the scale of standards, which are devised to show directly the percentages of carbon dioxide, the same set of standards used with B showing ten times the values indicated with A. A colorimetric box for comparing three tubes at a time may be conveniently employed. J. F. B.

**Estimation of Fluorine in Soluble Fluorides. J. G. Dinwiddie.** (*Amer. J. Sci.*, 1916, **42**, 464-468; through *J. Soc. Chem. Ind.*, 1917, **36**, 30.)—A neutral solution of the fluoride is heated to boiling, and powdered calcium sulphate is added; after standing for one hour, with frequent stirring, the precipitate, consisting of calcium sulphate and calcium fluoride, is washed several times by decantation and then collected on a filter. The latter consists of a disc of filter-paper fitted into the bottom of a perforated platinum crucible. The precipitate is now washed (the wash-water used should be saturated previously with calcium sulphate and calcium fluoride), then rinsed into an ordinary platinum crucible, and the water evaporated; the disc of filter-paper is, meanwhile, ignited on the crucible lid and the ash introduced into the crucible. The dry contents of the crucible are then heated at 300° C. for one hour, or until constant in weight, then sulphated, again heated at 300° C., and weighed. The increase in weight after sulphating is due to the replacement of two atoms of fluorine by the sulphuric acid radicle, and a simple calculation gives the quantity of fluorine present. The error of the method is about 0·1 per cent.

**Reactions for Distinguishing between Perchlorates, Periodates, Persulphates, Percarbonates, and Perborates. A. Monnier.** (*Ann. Chim. Analyt.*, 1916, **21**, 237-240 ; through *J. Soc. Chem. Ind.*, 1917, **36**, 30.)—The following reactions are given for the detection and identification of per-salts in aqueous solution, but the latter must be free from heavy metals, vanadates, tungstates, molybdates, bichromates, and ferricyanides. *Perborates and Percarbonates.*—These salts give the general reactions for boric acid, carbon dioxide, and hydrogen peroxide. To detect their presence when mixed with borates and carbonates, a portion of the solution is treated with dilute potassium bichromate solution acidified with sulphuric acid; a blue coloration indicates that a percarbonate or perborate is present. To identify a perborate, a solution of chrome alum is treated with an excess of the solution to be tested, ether and dilute sulphuric acid are added, and the mixture is shaken gently; the ethereal layer is coloured blue. Percarbonates and hydrogen peroxide do not give this reaction. *Iodates and Periodates.*—To the solution is added a small quantity of chloroform and then titanium trichloride solution; a white precipitate is formed and iodine is liberated, giving a violet-coloured solution with the chloroform. Titanium trichloride also liberates iodine from potassium iodide in the presence of chlorates or perchlorates, but in this case a white precipitate is not produced. The reaction with silver nitrate serves to distinguish periodates from iodates. If an alcoholic solution of benzidine is poured on the surface of the solution under examination, a brown zone appears in the presence of periodates, but not with iodates. *Chlorates and Perchlorates.*—A portion of the solution is shaken with the addition of potassium bromide, chloroform, and titanium trichloride solution ; chlorates liberate bromine, and this gives a brown chloroform solution, but perchlorates do not give the reaction. Another portion of the solution is treated, drop by drop, with a 0·2 per cent. methylene blue solution; a violet precipitate, which detonates when heated on a piece of platinum foil, indicates the presence of a perchlorate. In testing for chlorates and perchlorates, iodides, if present, must be removed previously by treatment with silver oxide, and iodates and periodates by means of silver nitrate, the excess of the latter being then removed by the addition of potassium bromide. *Detection of Bromates in the Presence of Chlorates and Iodates.*—To the solution is added manganous sulphate solution acidified with sulphuric acid; in the presence of a bromate the solution is coloured violet, owing to the formation of manganic sulphate, and bromine is liberated. This reaction is not given by chlorates or iodates. *Persulphates.*—In the absence of iodides and perchlorates, a rose-red precipitate is obtained when a persulphate is treated with methylene blue solution. Persulphates may be identified in the presence of perchlorates by pouring an alcoholic benzidine solution on the surface of the solution to be tested; a blue zone at the junction of the two liquids denotes the presence of a persulphate. A 2 per cent. aniline solution may be used in place of the benzidine solution.

**Combustion Methods for Use in the Laboratory (Estimation of Sulphur). J. Hewett.** (London and Southern Distr. Jun. Gas Assoc., Jan. 5, 1917. *Gas J.*, 1917, **137,** 72-73 ; through *J. Soc. Chem. Ind.*, 1917, **36**, 165.)—Sulphur may be estimated in volatile liquids—*e.g.*, crude benzols—by drawing air through the liquid and, after further diluting the air-vapour mixture, passing through a silica tube heated to redness, when complete combustion occurs. The gases then pass through two wash-bottles containing sodium hydroxide. After oxidation of the product with bromine or hydrogen peroxide, sulphur is estimated as sulphate in the usual way. The author indicates the wide applicability of the estimation of sulphur by combustion with sodium peroxide. It is carried out in a nickel crucible (see illustration) fitted with a screwed top and electrical ignition device. A ring of filter-paper makes a tight joint. The crucible may be immersed in water when the charge is fired. The substance under test must be thoroughly incorporated with the sodium peroxide in suitable proportions. The reaction should be complete in a few seconds. The contents of the crucible, when cold, are extracted with distilled water, and, after acidification and filtration, sulphur is estimated as sulphate in the usual way. This method may be used for any substance which can be brought to react vigorously with sodium peroxide, either alone or with the addition of sulphur-free combustible matter—*e.g.*, wood dust or alcohol. It has been used with tar and tar products, oils, fats, greases, coal, coke, new and spent oxide of iron. With spent oxides the reaction product is suitable for the estimation of iron and alumina as well as sulphur. The analysis of spent oxide in this way can be conducted much more speedily and conveniently than by the usual methods. The reaction is extremely violent. Not more than 1 grm. of combustible substance should be taken, and then 20 grms. of sodium peroxide usually give a suitable melt. The substance should be approximately free from moisture, as water may cause dangerous premature ignitions.



**Removal of Phosphoric Acid by Stannic Chloride. L. Gattermann and H. Schindhelm.** (*Ber.*, 1916, **49**, 2416-2422 ; through *J. Soc. Chem. Ind.*, 1917, **36**, 165.) — Working with 1 grm. of material, the filtrate from the hydrogen sulphide group is boiled until free from hydrogen sulphide, concentrated to 100 c.c., filtered if necessary, and treated with 5 c.c. of 6 per cent. ammonium phosphate solution. It is then nearly neutralised with dilute ammonia (until only faintly acid to litmus), 3 c.c. of dilute hydrochloric acid (7 to 8 per cent.) are added, and the briskly boiling solution is treated with 3 c.c. of a freshly prepared solution containing 3 grms. of crystallised stannic chloride, dissolved in the cold. Stannic phosphate is thus precipitated, and, if necessary, more of the stannic chloride solution is added in portions of 0·5 to 1 c.c., to the boiling solution until no further precipitate is obtained on testing a little of the filtered liquid with ammonia molybdate. The boiling solution is then filtered, using a Büchner funnel and double filter, the precipitate washed with boiling water, the warm filtrate, which should be quite clear, is treated with dilute hydrochloric acid and hydrogen sulphide to remove excess of tin, and the metals present are detected in the usual way. When the phosphate precipitate has a greenish colour, it is tested with caustic soda and hydrogen peroxide for chromium, which, like ferric (but not ferrous) iron, is liable to be carried down with the precipitate. If too little phosphoric acid be present, the mixture containing the stannic phosphate precipitate is difficult to filter, but satisfactory conditions are insured by adding ammonium phosphate as directed.

**Estimation of Free Sulphuric, Nitric, and Picric Acids in the Presence of Each Other. F. W. Richardson.** (*J. Soc. Chem. Ind.*, 1917, **36**, 13-15.)—Methods are described for the estimation of sulphuric, nitric, and picric acids in effluents from picric acid works. The picric acid is estimated colorimetrically in a Lovibond's tintometer; the yellow colour of the acid is easily comparable with the yellow units of the instrument, and there is no difficulty in standardising the yellow units against standard picric acid solutions. The use of a cell giving about 1 inch depth of solution will be found to be the most convenient. Since the coloration of a picric acid solution varies with the temperature, the observations should be made at some constant temperature—say, 15° or 20° C. The nitric acid is also estimated colorimetrically by means of phenoldisulphonic acid, allowance being made for the colour contributed by the picric acid, and the sulphuric acid is estimated by difference, the three acids being titrated in the presence of methyl-red, and the quantities of nitric and picric acids deducted from the result. For example, an effluent when examined in the tintometer showed a coloration equivalent to 0·28 grain of picric acid per gallon. Ten c.c. of the effluent were mixed with 5 c.c. of $\frac{N}{10}$ sodium hydroxide solution, evaporated to dryness, the residue was warmed for five minutes with the addition of 1 c.c. of phenoldisulphonic acid mixture, then diluted, rendered alkaline with ammonia, cooled to 15° C., diluted to 100 c.c., and observed in the tintometer. In this case the yellow units of the instrument were standardised against definite quantities of nitric acid under similar conditions; in calculating the quantity of nitric acid allowance was made for the colour of the picric acid at the corresponding dilution (ten times). Seventy c.c. of the effluent were then titrated with $\frac{N}{10}$ sodium hydroxide solution, using methyl-red as the indicator; after deducting the quantity of alkali neutralised by the nitric acid and picric acid (1 c.c. of $\frac{N}{10}$ sodium hydroxide solution corresponds with 0·00229 grm. of picric acid), the remaining amount of sodium hydroxide solution used for the titration was equivalent to the quantity of free sulphuric acid present.

With regard to the action of water containing small quantities of sulphuric acid and nitric acid on iron, the author finds that nitric acid may produce slightly protective coatings on the metal, but that this coating does not form when sulphuric acid is also present. The concentration of the water in boilers leads to extensive corrosion. Picric acid also acts readily on iron; as compared with sulphuric acid, the amount of iron dissolved is roughly proportional to the molecular equivalents, 49 parts of sulphuric acid producing the same effect as 229 parts of picric acid. W. P. S.

## REPORTS.

### The Food-Supply of the United Kingdom.*

THIS extremely interesting and important Report has been drawn up, at the request of the President of the Board of Trade, by a Committee of the Royal Society comprising A. D. Waller, M.D., F.R.S., Professor of Physiology in the University of London, Chairman : W. J. Ashley, Ph.D., Professor of Commerce in the University of Birmingham; A. W. Flux, M.A., Board of Trade; A. D. Hall, M.A., F.R.S., Development Commissioner; F. G. Hopkins, M.D., D.Sc., F.R.C.P., F.R.S., Professor of Bio-Chemistry in the University of Cambridge ; T. H. Middleton, C.B., Board of Agriculture and Fisheries ; D. Noel Paton, M.D., F.R.C.P.E., F.R.S., Professor of Physiology in the University of Glasgow; W. H. Thompson, M.D., D.Sc., F.R.C.P.I., Professor of Physiology in the University of Dublin; T. B. Wood, M.A., Drapers' Professor of Agriculture in the University of Cambridge.

It is full of data of a character which is as reliable as can be expected, considering the short time at the disposal of the Committee and the extreme urgency of the matters reported upon. The full Report should be in the hands of all chemists interested in problems connected with the relative composition of the more important food-stuffs, the quantities available prior to the War and the end of July, 1916, the possible methods of economy of the present supplies, and the economy in food which might be effected by the prohibition of brewing.

Part I. deals with the food-supply during the period 1909-1913. The problem of dealing with the extent and character of the food-supply in normal times is partly statistical, partly physiological. The quantities of the several food materials are set forth in tables, which also show the proportions home-grown and imported. The estimates have been based on fairly reliable data, and the cases in which the figures are largely conjectural are few. On the assumption that the population during the period was 45·2 millions, the following digest shows the calories† available.

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* Government Paper (Cd. 8,621), price 4d., published by His Majesty's Stationery Office.

† The calorie referred to in this Report is the quantity of heat required to raise a kgrm. of water 1° C.

| | Amounts. | Protein. | Fat. | Carbohydrate. | Energy Value. |
|---|---|---|---|---|---|
| | Metric Tons. | Metric Tons. | Metric Tons. | Metric Tons. | Million Calories. |
| Cereals .. .. | 4,865,000 | 549,000 | 63,000 | 3,628,000 | 17,712,000 |
| Meat .. .. | 2,685,000 | 356,000 | 799,000 | — | 8,890,000 |
| Poultry and eggs, game and rabbits | 331,000 | 42,000 | 31,000 | — | 461,000 |
| Fish .. .. | 848,400 | 91,000 | 17,000 | — | 531,000 |
| Dairy produce (including lard and margarine) .. | 5,231,800 | 199,000 | 686,000 | 258,000 | 8,253,000 |
| Fruit .. .. | 1,271,000 | 9,000 | 14,000 | 222,000 | 1,077,000 |
| Vegetables .. .. | 5,482,000 | 120,000 | 10,000 | 1,031,000 | 4,812,000 |
| Sugar (including cocoa and chocolate) .. .. | 1,657,000 | 5,000 | 18,000 | 1,572,000 | 6,633,000 |
| Cottage and farm produce not included above .. | — | 67,000 | 13,000 | 551,000 | 2,655,000 |
| Total .. | — | 1,438,000 | 1,651,000 | 7,262,000 | 51,024,000 |
| | | Grammes. | Grammes. | Grammes. | Calories. |
| Per head per day .. | — | 87 | 100 | 440 | 3,091 |
| Per " man " per day | — | 113 | 130 | 571 | 4,009 |

Of the total number of calories available—51,024,000 millions—29,731,000 millions represent imported food.

From the physiological standpoint, the nutritive value of the several foods, the standard requirements of the normal adult as regards each of the constituents of food requisite for healthy activity, and the needs, in proportion to that standard, of women and children, have been taken into account. Since women and children consume less food than men, 100 " men, women, and children " = 77 units—that is to say, " men."

In the calculations the Committee have followed Atwaters' values, modified in accordance with the special characteristics of the British food-supply.

The Committee are convinced that the dietary requirements of a nation engaged on active work cannot be satisfactorily met on a less supply in the food as purchased than 100 grms. protein, 100 grms. fat, 500 grms. carbohydrate, equal approximately to 3,400 calories per " man " per day, a " man " being an average workman doing an average day's work. The Committee have adopted this as their minimum standard. It will be seen from the figures quoted above that the supply has more than met our requirements in the past. Calculated on the *minimal* physiological standard, there has been wasted or consumed in excess of requirements of proteins 11 to 14 per cent., fats 25 to 30 per cent., and carbohydrates 10 to 14 per cent.

Part II. of the Report deals with the food-supply at the present period of the War, (July 29, 1916). The Committee has estimated the total population at 46·5 millions (equivalent to 35·8 million " men "), including our fighting forces at home and abroad and the refugees and prisoners in this country. The state of war involves the redistribution of food into (1) military and naval establishments, (2) civilian population. The following table is a comparison of the total amount of food available in metric tons per year, and the amount of food per " man " per day in grms. at the present time and in the period 1909-1913:

| | 1909-1913. | | 1916 (population 46·5 million at 0·77 man value ; 35·8 million " men "). | | | |
|---|---|---|---|---|---|---|
| | | | Military (4 million). | | Civil (35·8 – 4 = 31·8 million "men"). | |
| | Total. | Per "Man" per Day. | Total. | Per "Man" per Day. | Total. | Per "Man" per Day. |
| Protein .. .. | 1,438,000 | 113 | 204,400 | 140 | 1,233,600 | 106 |
| Fat .. .. .. | 1,651,000 | 130 | 262,800 | 180 | 1,388,200 | 120 |
| Carbohydrates .. | 7,262,000 | 571 | 730,000 | 500 | 6,532,000 | 563 |
| Calories .. .. | — | 4,009 | — | 4,300 | — | 3,859 |

The results show that on the pre-war basis of supply the food available for the civil population would be more than sufficient both as regards the supply of protein and of energy.

### The Supply of Food at Present Available.

The Committee have considered information furnished to them by the Board of Trade and Board of Agriculture, with reference to the supplies of meat, wheat, fish, and sugar for the total population up to the present time These, taken together, show a small increase in food values during the year ending June, 1916, as compared with pre-war conditions. There is no evidence that the supplies of other foods have, in the aggregate, been less than in the period prior to the War. Under these conditions it would seem that the amount of protein, fat, and carbohydrate per " man " has been maintained at about the level shown in the table.

The needs of our armies, the decreased yield of the harvest at home in 1916, and possible interference with our supplies from abroad, may reduce the supply in the future below this level.

Up to the present the supply of food has provided a general margin of about 5 per cent. above the minimum necessary for proper nutrition, and rather more as regards the supply of energy, so that a reduction to this extent would still furnish amounts of the essential food constituents conforming to the standard adopted in Part I. of the Report. Should such a reduction occur, it could be borne without serious injury to the community, but only on the condition that steps were taken to insure the equitable distribution of the available food throughout the population.

While the supply of food has, up to the present, been adequate for the support of the population, the rise in prices has accentuated the inequalities of distribution, which reduce the daily ration of many below the level of efficiency. Any curtailment of supplies, even to a limited extent, would result in the poorer classes obtaining less than is needful for safety should distribution remain unorganised.

The Committee, as physiologists, lay stress on the fact that in buying food the labouring population is buying energy—the power to do work. Increased cost of food (other things being equal) means increased cost of production. If the rising prices curtail for any class of the community its accustomed supply of food, its output of work will, of necessity, be reduced. It is important to remember that a slight reduction of food below the necessary amount causes a large diminution in the working efficiency of the individual.

In Part III. the possible methods of economising the available food-supply are dealt with, and the Committee have considered suggestions for the increase of the food-supply of the nation.

Here they have naturally limited themselves strictly to physiological considerations, without touching upon the important economic, social, and other questions which are involved. From this standpoint they are satisfied that the changes suggested would result in an economy of food without any significant dietetic disadvantages.

The suggestions are dealt with under the following headings: (1) A better recovery of flour in milling; (2) an increased economy in meat production; (3) an increase in the protein available for human consumption by increasing the manufacture of cheese, if need be, at the expense of butter-making; (4) the use as food of materials at present employed in brewing and distilling ; (5) the diversion of a certain quantity of material now used for stock-feeding to human food.

*The Possibility of a Better Recovery of Flour in Milling.*—Under the conditions which existed when the Report was written millers obtained on an average 70 per cent. of flour from cleaned wheat, the 30 per cent. of offal being sold for feeding stock. If the recovery of flour be raised to 80 per cent., wholesome and palatable bread can still be baked. Such bread is, however, considerably less digestible than bread made from "70 per cent." flour. The following figures show the gross gain in protein and calories available for human food which would result from the general adoption of the "80 per cent." standard:

| Milling Standard. | Home Production of Flour. | Protein. | | Calories. | |
|---|---|---|---|---|---|
| | | Total. | Digestible. | Total. | Digestible. |
| | Tons. | Tons. | Tons. | Millions. | Millions. |
| "80 per cent." .. | 4,775,000 | 573,000 | 464,000 | 17,376,000 | 15,117,000 |
| '70 per cent." .. | (2) 4,178,000 | 480,000 | 427,000 | 15,203,000 | 13,987,000 |
| Gain .. .. | 597,000 | 93,000 | 37,000 | 2,173,000 | 1,130,000 |

The gains of total protein and calories are large, but when corrected for digestibility considerably less than half the total gain of protein and about half the total gain of calories are available for the actual nutrition of the human body. A further correction is necessary for the decrease in production of pig meat due to the removal of wheat offals from the market. The corrected figures for protein and calories representing the net gain for human consumption which might result from raising the milling standard from " 70 to 80 per cent. " appears to be—

| | |
|---|---|
| Digestible protein .. .. .. .. | 31,000 metric tons. |
| Digestible calories .. .. .. .. | 816,000 millions. |

Or, per " man " per day for a population of 36 million " men," 2·36 grms. protein and 66 calories.

*Possibility of More Economical Meat Production.*—In discussing this matter the Committee employ the convenient term " starch equivalent " for expressing the relative nutritive values of fodders for fattening. For example, 100 lbs. of the following fodders are equivalent respectively to the following weights of starch: Medium hay, 31 lbs.; oat-straw, 17 lbs.; swede turnips, 7·5 lbs.; oats, 60 lbs.; linseed cake, 76 lbs.; barley offals, 65 lbs. By means of these and similar figures for other fodders, it is possible to calculate the starch equivalent of any mixed diet.

The following data make it possible to estimate the saving in starch equivalent which might result from the general production of beef by the slaughter of cattle when seventeen months old (" baby beef ") in place of the present general practice of slaughtering when two and a half years old:

At 17 months 4·5 lbs. starch equivalent should produce 1 lb. live weight.
or 8·0 ,, ,, ,, ,, ,, 1 ,, beef.
At 30 months 7·0 ,, ,, ,, ,, ,, 1 ,, live weight.
or 12·0 ,, ,, ,, ,, ,, 1 ,, beef.

In the five years before the War the average annual home production of beef was 750,000 metric tons.

Starch equivalent required to produce this at $2\frac{1}{2}$ years—9,000,000 tons.
,, ,, ,, ,, ,, at 17 months—6,000,000 tons.

The general production of " baby " beef would therefore set free about 3,000,000 tons of starch equivalent. This starch equivalent would be in the form of hay, straw, roots, grass, and oil-seed cakes, and would include very little wheat, oats, barley, maize, or other foods suitable for human consumption.

It might be used for the production of a further supply of home-produced " baby " beef, of which it would be capable of producing about 375,000 tons, which would yield for human consumption about 55,000 tons of protein and 1,000,000 million calories, or per " man " of a population of 36 million " men," 4·17 grms. of protein and 76 calories.

" Baby " beef will not be so fat as steer two and a half years old, but the protein value will be much the same in both cases. It appears likely, therefore, that the calculated increase in the supply of protein might be realised. An increase in calories, however, is very problematical. The universal production of " baby " beef in place of steer beef is not immediately practicable. It would require much organisation, especially in the care, purchase, and distribution of suitable calves, and in many districts would also involve considerable alterations in the system of farming.

Considerable economies might also be effected by lessening the overfeeding of oxen during the winter months. It is estimated that this loss works out at a loss of 64,000 tons of starch equivalent, which if properly used might produce some 8,000 tons more beef.

A further economy would result from discontinuing the fattening process as soon as there is no longer an appreciable increase in live weight.

Considerable economy in fodder can be effected by the kind of animal to which it is fed. All animals are by no means equally good "converters," as is shown by the following figures:

| lb. Starch equivalent in Fodder | required to produce | 1,000 Calories in the Form of— |
|---|---|---|
| 2·9 | | milk from good cow. |
| 3·0 | | pig meat. |
| 4·7 | | veal. |
| 4·7 | | milk from bad cow. |
| 5·3 | | mutton. |
| 7·0 | | eggs. |
| 7·0 | | "baby" beef. |
| 9·0 | | steer beef. |

These figures justify the agricultural policy of most Continental countries, which rely on dairy products, pig meat, and veal for a very large proportion of their supply of animal food. A given supply of fodder is capable of producing a far greater amount of protein and calories in these forms than if it is used to a very large extent, as in Great Britain, for the production of mutton and beef.

*The Possible Increase in the National Food-Supply which might Result from a General Practice of making Cheese in Place of Butter.*—It is possible that the general adoption of cheese-making in place of butter-making might adversely affect the number of calves reared in the country, and in view of the possible development of "baby" beef production this is undesirable. Calves can be reared satisfactorily if started on whole milk for the first five or six weeks, during which time each calf would consume 50 gallons. Of the 2½ million calves in the United Kingdom, a considerable proportion suck their mothers, and are, therefore, not affected by the abolition of skim milk; but in order to allow for expansion of the calf-rearing industry, the calculation is based on the whole 2½ million calves at present reared. To provide 50 gallons of whole milk for each of these calves would call for 125 million gallons. Deducting this from the 625 million gallons at present used for butter, 500 million gallons would remain for cheese-making.*

Assuming that 2½ gallons of milk are required to make 1 lb. of butter, whilst 1 gallon of milk makes 1 lb. of cheese,

500 million gallons of milk make 228,000 tons of cheese, which would contain 57,000 tons protein.

The present yield of home-made butter contains 1,000 tons protein.

The gain of protein would therefore be 56,000 tons.

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* In the original, tables are given showing the quantities of milk, etc.

The starch equivalent of whey is less than the starch equivalent of separated milk by 2 lbs. per 10 gallons. On 500 million gallons of milk made into cheese instead of butter, this represents a loss of 45,000 tons of starch equivalent. Assuming that separated milk and whey are both used for pig-feeding, and that 4½ lbs. starch equivalent give 1 lb. of pig, this represents a deficit of 10,000 tons of pig, or 8,000 tons of pig meat, containing 800 tons of protein. The net gain which might be realised by the general adoption of cheese-making in place of butter-making is, therefore, 55,000 tons of protein, or, per " man," 4·2 grms. per day.

The question of energy value is not considered, since both butter and cheese contain practically the same proportion of the fat of the milk, and the change from butter-making to cheese-making will not greatly affect the number of calories available for human food.

The Committee dwell at some length with the economy in food which might be effected by the prohibition of brewing. It is pointed out that a complete statement of the case for and against any proposal to divert materials used in brewing to any other purpose would necessarily have to include a consideration of the cost of production (labour and fuel) in each case. Neglecting these factors and confining themselves to the quantities of food and of energy available for human use, the conclusions arrived at may be summarised as follows: The beer, together with the milk obtained indirectly from the by-products of the brewery, contain between 28 per cent. and 59 per cent. of the energy, and less than 27 per cent. of the protein, of the original material; whereas if these materials were not brewed, but utilised in the theoretically best possible manner, about 71 per cent. of the energy, and 68 per cent. of the protein would be recovered as human food. This very high recovery is possible only if the use of the barley and other materials as food for live stock is equally prohibited. If, as would otherwise be the case, they were converted into meat, only 15 per cent. of the energy and 17 per cent. of the protein would be realised as human food.

In discussing the alcohol question the Committee are of the opinion that alcohol as a source of maintenance and of work-power for the nation cannot, as in the case of a normal food-stuff, be logically measured by its gross calorific value.

EDITOR.

**Report of the Government Chemist upon the Work of the Government Laboratory for the Year ended March 31, 1916, with Appendices.** (Issued as a Parliamentary Paper, Cd. 8394, pp. 1-22.)—The total number of samples examined during the year was 239,706, as compared with 230,404 in the previous year; in addition to the above number, 144,186 samples were examined at the chemical stations in different parts of the United Kingdom. The samples of foods analysed in connection with the supply of the Expeditionary Forces alone numbered 8,901, and a large amount of work was carried out in dealing with questions relating to contraband trading with the enemy.

The chemical work of the following departments and other public bodies is now performed wholly or in part in the Government Laboratory: Board of Customs and Excise, Admiralty, Board of Agriculture and Fisheries, Central Control Board (Liquor Traffic), Department of Agriculture and Technical Instruction for Ireland, Colonial Office, Crown Agents for the Colonies, Foreign Office, Geological Survey, Home Office, India Office, Public Record Office, Stationery Office, Board of Trade, Trinity House, War Office, War Trade Department, Office of Woods and Forests, Office of Works (London and Dublin.)

CUSTOMS AND EXCISE.—*Beer.*—The total number of samples examined in connection with the beer duty was 44,551. The quantity of beer imported is relatively small, but drawback is allowed on exported beer whether or not it has been manufactured in this country; many samples were examined to check the claims made by the exporters. *Materials used in Brewing.*—Of 316 samples examined, 219 were samples of malt, corn, brewing sugars, and brewers' grains, and 97 were samples of yeast foods and miscellaneous substances. Three hundred and fifty samples of finished beer from brewers' premises were examined for saccharin, saponin, and other prohibited ingredients, but, except occasional traces of arsenic, nothing of a deleterious or illegal character was found to be present. *Worts or Beer in the Unfinished Condition.*—The number of samples examined was 11,198; the original gravity was declared by the brewers at less than the true gravity in 2,931 cases, the percentage of under-declarations being 33·3 per cent. The increase, compared with previous years, in the number of cases in which worts were found to be under-declared is probably largely due to the fact that the new original gravity table legalised by the Finance Act, 1914, permits a more accurate determination of the true original gravity of partly fermented worts than was possible with the table formerly in use. Under the provisions of this Act repayment or remission of duty can be claimed by brewers on all beer which has been returned to them by customers as unfit for consumption, whilst formerly repayments of duty were made only in special cases where spoiled beer had never left the brewery premises. *Beer as Retailed.*—The beer was found to have been diluted in 152 cases out of 4,964 samples taken from the premises of publicans and other retailers; some of the samples were diluted to the extent of 10 to 14 gallons of water per barrel of 36 gallons. *Herb Beers, Beer Substitutes, and Other Temperance Beverages.*—The percentage of alcohol was estimated in 191 samples: 144 contained less than 2 per cent. of proof spirit, 31 contained between 2 and 3 per cent., 7 between 3 and 4 per cent., and 5 from 4 to 7 per cent. *Imported Beer.*—The number of samples examined was 4,202. Twelve samples, described on importation as "malt extract," were found to correspond with beer, and were charged duty accordingly. *Examination of Beer and Brewing Materials for Arsenic.*—Of the 256 samples of malt and sugar tested, none contained arsenic in excess of the limits suggested by the Royal Commission on Arsenical Poisoning. Four samples of beer, out of a total of 1,418, contained more than $\frac{1}{100}$ grain of arsenious oxide per gallon, the highest proportion found being $\frac{1}{26}$ grain per gallon. Two cases of excess were detected in the 123 samples of miscellaneous samples examined, the largest amount of arsenic found being $\frac{1}{56}$ grain per gallon. The substances in which the amount of arsenic exceeded the limit were not allowed to be used in brewing. *Cider and Perry.*—Some of these beverages, sold under fancy names, are mixtures of real cider with sugar solution; whilst many non-alcoholic ciders, so called, are entirely free from fermented apple-juice, and are simply aerated and flavoured sugar solutions. The use of any name for such beverages which suggests that they consist of fermented apple-juice is an infringement of the Merchandise Marks Act, and is also harmful to the interests of makers of genuine cider. Of 123 samples of imported cider examined, 3 were factitious; of 7 samples purchased as cider by the Customs and Excise officers, 1 was commercial cider containing 4·6 per cent. of proof spirit, and 6 were prepared liquids which contained no apple-juice. *Wash, Yeast-Pressings, etc.*—During the year, 3,029 samples of fermented wash and other liquids produced in the manufacture of spirits were analysed; the declared gravity of the wash was found to be understated in 15 cases. *Fusel Oil.*—Only 1 sample out of 18 examined contained more than the permitted proportion (15 per cent.) of proof spirit. *Illicitly-distilled Spirits.*—Four samples of spirits suspected to have been obtained by illicit distillation were examined; proof that the spirits had in fact been so produced was supplied by the results of the analysis in three cases, and legal proceedings followed. *Liqueur Chocolates.*—The proportion of proof spirit contained in 24 samples of these articles ranged from 0·7 to 21·9 per cent., and legal proceedings were instituted in 4 cases. In 606 samples of imported liqueur chocolates, the average quantity of proof spirit was 3·1 per cent., the highest being 14·7 per cent. *British Spirituous Preparations exported.*—In addition to 3,081 samples of liniments, hairwashes, etc., which were tested for the presence of methylated spirit, 19,337, samples of medicinal spirits, tinctures, perfumes, extracts, infusions, etc., were examined as to their character and alcoholic strength, in order to check the exporters' claims for drawback; no evidence of the illicit use of methylated spirit was detected, but in 763 cases the declared spirit strength was overstated. *Methylated Spirit.*—Thirteen hundred and fifty-three samples of wood naphtha and of mineral naphtha, intended for use in the preparation of methylated spirit, were approved. Twenty-one samples of petroleum spirit, used in admixture with methylated spirit in the manufacture of felt hats, were also approved; 268 samples of still residues, 12 samples of mineralised methylated spirit, 28 samples of duty-free alcohol, and 83 samples of specially denatured alcohol and denaturing substances, were examined. *Wines.*—In connection with the assessment of various duties, 92,075 samples of imported wines were examined as to their alcoholic strength. Eight samples of medicated wines, 35 of British wines or sweets, and 26 of foreign wines, were also examined in connection with the duty on wine and the liability to payment of a licence duty for its sale. *Tobacco.*—During the year the percentage of moisture was estimated in 13,622 samples of manufactured tobacco, and the percentage of oil in 2,308 samples. The number of certificates issued in connection with return of duty on exported tobacco and snuff was 81,889, an increase of 48,179 over the number for the previous year; this increase was due to the despatch of tobacco for the use of the British Expeditionary Forces. By regulations based upon the provisions of the Finance Act, 1904, manufacturers are allowed drawback on offal tobacco, fixed, as in the case of manufactured tobacco, on the basis of a moisture content of 14 per cent., with a corresponding increase or decrease in the amount of drawback according as the proportion of moisture is above or below this standard, and subject to the same regulations as to the amounts of inorganic matter and sand except in the case of "offal" tobacco falling under the head of "snuff." In this case there is no legal limit for the amount of sand which may be present, but drawback is paid without deduction only when the total inorganic matter (including sand) does not exceed 22 per cent. calculated on the dry tobacco. The samples of offal tobacco examined numbered 46,135; other samples comprised 338 of tobacco leaf from the stocks of licensed manufacturers, 1,498 of unmanufactured tobacco (including 199 samples of tobacco grown in the United Kingdom), and 1,145 samples of miscellaneous substances. *Sugar, Glucose, Saccharin.*—The number of samples of sugar and articles containing sugar examined for assessment of duty or drawback was 24,682, including 21 samples of sugar, molasses, and beetroot, from the British beetroot sugar factory at Cantley. The imported articles containing sugar consisted of biscuits, cakes, ketchup, chutney, confectionery, condensed milk, crystallised fruit, desiccated coconut, drugs, fruit-pulp, infants' and invalids' foods, lozenges, invert sugar, jam, milk-powder, pickles, soy, egg yolk, gelatin, glue, honey, manna, meat extracts, parchment paper, printers' roller composition, and tanning extracts. Honey, although not liable to duty when genuine, is frequently adulterated with invert sugar, and duty is charged accordingly. Glucose manufactured in this country is subject to an Excise duty, and 941 samples were examined in all. Saccharin was detected in 38 samples out of 309 samples of condiments, dentrifices, and medical preparations. *Tea.*—Of 15,052 samples of tea entering the country, 1,616 were condemned as containing sand or other foreign matter, and 84 samples were reported as being unfit for human consumption. The quantity rejected, 114,844 pounds, was insignificant in relation to the total amount of tea imported—namely, 420 millions of pounds. *Coffee and Coffee Substitutes.*—Three samples out of 1,745 submitted for exportation were found to contain chicory, and drawback was disallowed in these cases. *Cocoa and Chocolate.*—The duty is calculated on the actual proportion of dutiable ingredients (cocoa, sugar, and cocoa fat), and drawback is allowed on the same basis; 3,112 samples of cocoa and its preparations were examined during the year for this purpose. *Matches.*—The presence of white phosphorus was not detected in any of the 375 samples examined. *Medicines.*—Forty-two samples of pills, powders, plasters, herbs, ointments, lotions, tonics, corn cures, etc., were analysed to determine their compliance with the requirements of the Medicine Stamp Acts.

ADMIRALTY.—The work for this department consisted in the examination of food substances and of metals, soaps, pottery glazes, oils, etc. Nearly all the samples of dairy produce were genuine and of good quality, but some samples of condensed milk did not conform to the specified standard, and many butters tendered to naval hospitals contained boron preservative contrary to the specification.

BOARD OF AGRICULTURE AND FISHERIES.—Two thousand four hundred and three samples were examined for this Board, including those for the Board of Agriculture for Scotland and the Department of Agriculture and Technical Instruction for Ireland. *Imported Milk and Cream.*—Fifty-six samples of condensed milk and 26 of condensed skimmed milk were analysed; the percentage of fat in the former samples ranged from 8·1 to 11·3, and all the samples were free from preservatives. Of the 23 samples of dried milk examined, 9 were whole-milk powders, and 14 had been prepared from skimmed or separated milk. No fresh milk was imported during the year; 18 samples of imported sterilised milk conformed with the requirements of the Sale of Milk Regulations. Fifteen samples of imported cream were taken; the fat in the " churn " cream varied from 48·3 to 52·6 per cent., and in the " tinned " cream from 23·7 to 34·4 per cent. All the samples of churn cream were preserved with boric acid, the largest amount found in any sample being 0·45 per cent. *Imported Butter.*—There was no evidence of the presence of foreign fats in any of the 1,037 samples analysed; 402 of the samples contained boron preservative, 42 added colouring matter, and 6 contained more than 16 per cent. of water. The Reichert-Wollny value fell below 24 in 42 cases; of these, 5 gave values below 22, 13 between 22 and 23, and 24 between 23 and 24. *Imported Margarine.*—All the 524 samples examined contained less than 10 per cent. of butter fat, but water in excess of the legal limit was found in eight cases. *Imported Cheese.*—Sixty-eight samples were examined; all were free from foreign fat, but several had been prepared from skimmed milk. *Samples of Produce taken under the Butter and Margarine Act.*—The inspectors of the Board submitted 302 samples of butter and 5 samples of margarine for analysis; 45 of the butters contained an excess of water, and 5 of the samples consisted of mixtures of butter and margarine. *Sheep Dips.*—Thirty-one samples of sheep dips were received for examination as regards their fitness for inclusion in the official schedule of efficient dips; 9 of the samples were satisfactory, 12 were deficient in active ingredients at the dilution submitted by the makers, and in 10 cases the formulæ required modification. Analyses of 12 samples of approved dips purchased in different parts of the country showed that 3 had not been prepared according to the formulæ previously submitted and approved. The miscellaneous samples examined for the Board included various waste materials as to their value as fertilisers; oysters, cockles, and mussels, as to their food value; nut-meal middlings, basic slags, ground felspar, and soils. *Questions submitted by the Board for Report.*—The following amongst many other matters were submitted: The adulteration of dried grains; the supply of potash and the value of various refuse materials as sources of potash; the solubility of the phosphates in basic slags produced by modifications in the process of steel manufacture; the composition of cheese; the Sale of Milk Regulations and analysts' certificates issued in connection therewith; the utilisation of various by-products as feeding-stuffs or as fertilisers.

FISHERIES DIVISION.—Twenty-five samples of river-water, believed to have been polluted and to have caused injury to fish, were examined; two sea-trout taken from one of the streams were found to contain traces of copper, lead, and zinc. Estimations of salinities were made in 2,337 samples of sea-water for the Permanent International Council for the Exploration of the Sea.

CENTRAL CONTROL BOARD (LIQUOR TRAFFIC).—Forty-three samples of beer and whisky were analysed for the Board, and assistance was given in connection with various technical questions.

CROWN AGENTS FOR THE COLONIES.—The samples analysed for this department comprised 82 of drugs and pharmaceutical preparations taken mainly from contract supplies, and 101 of foods for troops serving in East and West Africa.

HOME OFFICE.—As in previous years, the dangers connected with the use of lead, especially in glazes and enamels, continue to receive a large amount of attention. The samples of glazes examined were generally found to comply with the department's requirements. With regard to the solubility of certain lead glazes in dilute acid, it was found, in 19 cases where lead-poisoning had occurred, that almost all the lead was soluble in hydrochloric acid of the strength found in the gastric juice. Samples of stores supplied on contract to the Prison Commissioners, and certain fire-extinguishing powders, which were stated to be effective for use in cases of fire due to incendiary shells, were also examined. The varnish on some "gaines" used in shells was analysed to ascertain whether it contained anything likely to be injurious to workpeople.

INLAND REVENUE.—About 140 samples of inks, experimental stamps and paper were examined; for the Estate Duty Branch some clays were analysed in connection with their liability to Mineral Rights Duty.

LOCAL GOVERNMENT BOARD.—*Preservatives in Food.*—All the samples of milk and cream taken under the Food and Drugs Acts and the Public Health Acts, with the exception of a limited number of samples of churn cream which contained boric acid, were free from preservatives. No preservative other than boric acid was found in the butter samples. The butters imported from Russia, Denmark, Norway, and Sweden, were free from boric acid. *Old Age Pensions Act.*—One document was submitted for examination on account of its suspicious appearance.

POST OFFICE.—The articles analysed consisted of paper, pigments, gum, obliterating fluids, materials used in the telegraph and telephone services (such as tin, lead, spelter, and amalgamated zinc rods), coal, soap, cycle tyres, sealing-wax, copper sulphate, waterproof coats, white and red lead, and calcium carbide. Samples of air and of drinking-water were analysed on behalf of the Medical Department of the Post Office, and the services of the laboratory were also required in numerous cases of suspected fraud in connection with the use of stamps.

BOARD OF TRADE.—*Lime and Lemon Juice for the Mercantile Marine.*—Of the 2,069 samples of raw lime-juice examined, only 4 were rejected as unsuitable, whilst 10 samples of lemon-juice out of a total of 131 were found to be unfit for use. Thirty-four samples of rum were approved. Three hundred and seven samples of fortified lime and lemon juice (containing rum) were examined, and 16 were rejected. Several samples of approved disinfectants were submitted for analysis, and questions in connection with the export of materials likely to be of use to the enemy were dealt with.

WAR DEPARTMENT.—The 8,901 samples of food-supplies examined included army biscuits, flour, bread, pearl barley, oatmeal, arrowroot, sago, tapioca, desiccated potatoes and other vegetables, milk, cocoa, jam, meat extract, pepper, mustard, beer, tinned meats, butter, cheese, etc. The contractors' deliveries were also supervised. One sample of gold lace, 21 samples of anæsthetics, and samples of water from military stations, were analysed.

WAR TRADE DEPARTMENT.—A licence is required to export goods falling under any prohibition order, and in doubtful cases reference is made and samples are submitted to the Government Laboratory for the purpose of advising whether they are subject to restriction. During the year, 1,681 references of this kind were dealt with.

OFFICE OF WORKS, LONDON.—The samples examined consisted largely of materials supplied by contractors for the public service, and included oils, soaps, paints, varnishes, disinfectants, and rubber; samples of water from various public buildings were also analysed.

OFFICE OF WORKS, DUBLIN.—Samples of water were analysed, and some anthracite coals were examined for calorific value and quality.

SALE OF FOOD AND DRUGS ACTS.—*Examination of Samples referred by Magistrates under the Sale of Food and Drugs Acts of* 1875 *and* 1899.—Seventy-five samples were received, consisting of 64 samples of milk, 5 of butter, 2 of rum, 1 each of cream, whisky, coffee, and ipecacuanha wine. The results of the analyses differed from those of the public analyst in 10 out of the 70 cases in which certificates were issued; the disagreements in respect of the milk samples were 7 out of 59. The following are the particulars of some of the more important cases: *Butter.*—In 3 cases the butter was found to contain excess water, and in 1 case boric acid, as alleged by the public analyst; in the remaining case there was no evidence of the presence of boric acid as stated. *Whisky and Rum.*—In these cases the samples were alleged to be below the statutory limit of strength, and the results obtained confirmed those of the public analyst except as regards one of the samples of rum. The ipecacuanha wine was alleged to be deficient in alkaloids, but the result of the analysis did not confirm the conclusions of the public analyst; in the case of the samples of coffee alleged to contain chicory, and cream alleged to contain excess boric acid, the findings of the public analyst were confirmed. *Milk.*—In the 59 cases in which certificates were issued, the charges were as follows: In 21 cases, added water; 22, abstraction of fat; 8, added water and abstraction of fat; 3, presence of formalin or mystin; 1, presence of colouring matter and abstraction of fat; 4, presence of dirt.

FERTILISERS AND FEEDING-STUFFS ACT.—The number of samples received was 44, consisting of 9 fertilisers and 35 feeding-stuffs. The fertilisers comprised superphosphate, basic slag, bone meal, and potato manures; they were deficient in phosphates or nitrogen. The feeding-stuffs examined consisted of feeding meals and cakes, milling by-products, and poultry foods. Several of the meals were deficient in oil or albuminoids, and in some cases the sample contained a considerable proportion of substances unsuitable for feeding purposes.

Members of the staff gave evidence in legal proceedings in 25 cases. The latter included offences connected with the Post Office, War Trade Department, Food and Drugs Adulteration, Old Age Pensions, Liquor Control Regulations, and the various Revenue Acts.

Details as to the number of analyses made and materials examined during the year are given in the appendices to the Report. W. P. S.

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## GOVERNMENT ORDERS.

64,482] (*8th February*, 1917.)

### MILK AND CREAM REGULATIONS: AMENDING ORDER.

To the several Local Authorities in England and Wales for the time being authorised to appoint an analyst for the purposes of the Sale of Food and Drugs Acts, 1875 to 1907; to Officers of Customs and Excise; to the Principal Chemist of the Government Laboratories; to Medical Officers of Health; to Public Analysts; to Dairymen, and to Wholesale and Retail Dealers in Milk and Cream; and to all others whom it may concern.

WHEREAS, for the prevention of danger arising to public health, We, the Local Government Board, by the Public Health (Milk and Cream) Regulations, 1912 (hereinafter referred to as " the Regulations "), made certain Regulations in relation to Milk and Cream;

And whereas by sub-division (1) of Article IV. comprised in Part II. of the Regulations it is, amongst other things, provided that no person shall add, or order or permit any other person to add, to cream containing 35 per cent. or more by weight of milk fat any preservative substance other than—

(i) boric acid, borax, or a mixture of those preservative substances; or
(ii) hydrogen peroxide

in any case in which the cream is intended for sale for human consumption; and by sub-division (2) of Article IV. it is provided that no person shall sell, or expose or offer for sale, or have in his possession for the purpose of sale, any cream to which any preservative substance has been added in contravention of the provisions of sub-division (1) of the Article;

And whereas by sub-division (2) of Article V. comprised in Part II. of the Regulations it is, subject as therein mentioned, provided that no seller of preserved cream shall deposit for sale in any place, or despatch or deliver to any purchaser, or to any other person, any receptacle containing preserved cream intended for human consumption unless the receptacle is labelled in the manner prescribed in the Schedule to the Regulations and unless, in the case of preserved cream containing boric acid, borax, or a mixture of those preservative substances, the amount of those substances calculated as boric acid ($H_3BO_3$) is accurately stated as not exceeding the limit specified on the label in the manner prescribed in the said Schedule;

And whereas by Article VIII. comprised in Part III. of the Regulations it is, amongst other things, provided that no person shall import into England or Wales any foreign cream containing 35 per cent. or more by weight of milk fat to which has been added any preservative substance other than—

(i) boric acid, borax, or a mixture of those preservative substances; or
(ii) hydrogen peroxide;

or any foreign preserved cream which is not contained in a vessel or receptacle duly labelled in the manner prescribed in the Schedule to the Regulations;

And whereas it is expedient that the Regulations should be amended as hereinafter set forth;

And whereas the Commissioners of Customs and Excise have signified their consent to the amendments of the Regulations so far as they apply to the Officers of Customs and Excise:

NOW THEREFORE, We, by this Our Order, and in the exercise of the powers conferred upon Us by the Public Health Act, 1875, the Public Health (London) Act, 1891, the Public Health Act, 1896, and the Public Health (Regulations as to Food) Act, 1907, and of every other power enabling Us in that behalf, do hereby Order that on and after Monday the Second day of April, 1917, the Regulations shall be read and have effect as if—

(*a*) the words " in amount not exceeding 0·4 per cent. boric acid ($H_3BO_3$) by weight of the preserved cream " were inserted in Article IV. and also in Article VIII. of the Regulations after the words " boric acid, borax, or a mixture of those preservative substances ";

(*b*) for the paragraphs numbered respectively 1, 2, and 5 in the Schedule to the Regulations there were substituted the following paragraphs, that is to say:

" 1. Every receptacle containing preserved cream shall be labelled by affixing thereto an adhesive label in the form prescribed, in this Schedule referred to as the ' declaratory label.' Provided that, where the receptacle is made of cardboard, the declaratory label may be printed on the outside of the cardboard itself.

" 2. Every declaratory label shall be in the form and contain the information indicated in Label I. or Label II. set out in this Schedule, as the case may require. Such information shall be printed in dark coloured type, of not less size than that shown in the said Label I. or Label II., upon a white or cream coloured ground in the centre of the declaratory label, and nothing else shall be printed on the declaratory label; except that in every case in which Label I. is used the maximum amount per cent. of boric acid ($H_3BO_3$) contained in the preserved cream shall be stated in figures on the declaratory label.

" LABEL I.

**PRESERVED CREAM**
*containing* **BORIC ACID**
*not exceeding* **PER CENT.**
**NOT SUITABLE FOR**
**INFANTS OR INVALIDS.**

LABEL II.

**PRESERVED CREAM**
**(PEROXIDE)**
**NOT SUITABLE FOR**
**INFANTS OR INVALIDS.**

" 5. The declaratory label shall not be affixed or printed either over the mouth of the receptacle or beneath the receptacle."

This Order may be cited as " The Public Health (Milk and Cream) Regulations, 1912, Amendment Order, 1917."

Given under the Seal of Office of the Local Government Board, this Eighth day of February, in the year One thousand nine hundred and seventeen

RHONDDA, *President.*
H. C. MONRO, *Secretary.*

LOCAL GOVERNMENT BOARD,
WHITEHALL, S.W.,
*9th February*, 1917.

## PUBLIC HEALTH (REGULATIONS AS TO FOOD) ACT, 1907.

*Amending Regulations with respect to Cream.*

SIR,

I am directed by the President of the Local Government Board to transmit to you the enclosed copies of an Order which has been made amending the Public Health (Milk and Cream) Regulations, 1912.

Numerous representations have been made to this Department on the subject of boric acid in cream. Some of these representations have urged that the use of preservatives in cream should be wholly prohibited; others have urged that it would be impracticable to carry on the present trade in jugged cream unless some small amount of preservative is added, and the Department has been asked to lay down a maximum limit.

The question is one of some difficulty, and it has been decided to appoint a small expert Committee for the purpose of inquiring further in regard to it.

In consequence of the War, the appointment of this Committee has necessarily been postponed, and as an interim measure, Lord Rhondda has decided to issue the Order, copies of which are enclosed. This Order prescribes that not more than 0·4 per cent. of boric acid shall be added to cream, that cream to which boric acid has been added shall be sold as preserved cream, and that there shall be affixed to the receptacle containing such cream a label stating that cream containing boric acid is unsuitable for infants and invalids.

The inquiry which it is proposed to institute may show that the limit should be less than 0·4 per cent., which is the maximum fixed by the present amending Regulations. Attention is drawn to this point in order that dealers in this article may make every effort to reduce the preservative to the smallest possible amount or even to dispense with its use entirely. By adopting this course the trade will find less difficulty in complying with any further restrictions which may be made as a result of the findings of the Committee referred to.

In temporarily forbidding a greater addition of boric acid than 0·4 per cent., the Department must not be regarded as deciding the question proposed for inquiry as to whether this amount of boric acid is or is not injurious to the consumer; but pending the result of the proposed inquiry, Lord Rhondda would deprecate any prosecutions being instituted in respect of the sale of preserved cream which complies with the Regulations as now amended.

The Order comes into operation on the 2nd of April next.

Copies of the Order and of this Circular are also enclosed for transmission to the Medical Officer of Health and Public Analyst.

The Order and this Circular will be placed on sale, and copies may shortly be obtained, either directly or through any bookseller, from His Majesty's Stationery Office, Imperial House, Kingsway, London, W.C.

I am, Sir,
Your obedient Servant,
H. C. MONRO, *Secretary.*

*The Town Clerk,*
or
*The Clerk to the County Council.*

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## REVIEWS.

TEXTBOOK OF QUANTITATIVE CHEMICAL ANALYSIS. By A. C. CUMMING, D.Sc., and S. A. KAY, D.Sc. London: Gurney and Jackson; Edinburgh: Oliver and Boyd. Second edition, 1916. Price 9s. net.

In the production of a Textbook of Analytical Chemistry, the first and perhaps not the least of the difficulties confronting the author is to decide precisely for what class of readers the book is intended. It is obvious that one and the same textbook cannot advantageously be addressed to the elementary student, the advanced student, and the professional analyst.

In their preface the authors state that this work (a review of the first edition has already appeared—ANALYST, 1914, **39,** 240) "is intended primarily for University and college students," and they add that "in planning it we have not overlooked the fact that those who study chemistry as a subsidiary subject usually devote so short a time to it that it is impossible for them to cover any comprehensive course; and that, even when chemistry is one of the main subjects of study, the student as a rule has a strictly limited time for laboratory work." They also add that they have dealt with volumetric analysis before gravimetric analysis, because "the educative value of volumetric methods is probably greater than that of any other branch of analysis; and we are of opinion that a student should receive a thorough training in volumetric analysis even if the time remaining at his disposal permits of but little gravimetric work." It is unhappily true that numbers of students, "even when chemistry is one of the main subjects of study," are taught in such a superficial manner that the instruction they receive is neither useful from the educational, nor, indeed, from any other point of view; and it is rather a pity that two authors of the standing of Dr. Cumming and Dr. Kay, in catering for such students, should appear to countenance such a class of teaching. It is this which has been partly responsible for the low esteem in which analytical chemistry has been so often held in the past, and for the widespread belief that every general practitioner is qualified to practise toxicology, to say nothing of general chemical analysis, and that every medical officer of health is an authority on the chemical composition and analysis of all the products coming within the purview of the Sale of Food and Drugs Acts.

The uncertainty as to the audience to whom the authors are addressing themselves renders a critical review of the book somewhat difficult. This will be clear when it is pointed out that, whilst the book contains much matter obviously intended for the absolute beginner, it deals with the analysis of ores and alloys, the complete analysis of superphosphate manure, technical gas analysis, water analysis, quantitative organic analysis, and the determination of molecular weights.

In the section devoted to volumetric analysis, which is, according to the authors, intended for elementary students who may not have time to study more than the rudiments of gravimetric analysis, one finds methods for the determination of the iron in natural silicates and slags, and the determination of iron and chromium in chrome iron ore.

In the section devoted to systematic quantitative analysis, the authors have retained the alphabetical system, which, so far as the writer can see, does not present any advantage, and which is surely less satisfactory from the point of view of the student than an arrangement based upon chemical relationships. Thus, barium and calcium are separated from one another by bismuth, boron, bromine, and cadmium; whilst strontium, which can scarcely be regarded as a rare element, is entirely omitted.

The section devoted to water analysis is open to some criticism. Thus, under the heading "nitrate" the student is instructed to apply the brucine test, and, if nitrate is present, to estimate it by the copper-zinc couple, no reference being made to Crum's method, which is by far the most accurate when the amount of nitrate present exceeds a very small amount.

Under the heading "nitrite" the authors refer to "Llosvay's reagent." It should be pointed out that this method is due to Peter Griess, Llosvay having merely recommended the substitution of acetic acid for a mineral acid. The correct description is therefore the Griess-Llosvay reagent.

In recommending the ignition of the water solids after weighing "in order to obtain an idea of the amount of organic matter present in the residue," the student might well have been warned that, given much nitrate, there would be little charring even in the presence of a considerable amount of organic matter.

In referring to the bacteriological examination of water, the authors remark: "It is usually necessary to examine the water more especially for pathogenic bacteria." As a matter of fact, such an examination is but rarely made, since the discovery of definitely pathogenic bacteria would be the equivalent of locking the stable door after the horse had been stolen. The student should be taught that what is of the greatest importance is to establish either by chemical or by bacteriological means—or, better still, by both—the presence or absence of polluting organic matter. In the former case the water may be described as potentially, if not actually, dangerous, and those who are accustomed to use it may be warned in due time.

Among the many excellent features of this book are the sections devoted to elementary electrolytic processes and to the estimation of traces of certain elements by colorimetric methods. This latter section might well have been extended to include nickel. It may be noted in this connection that no reference is made to the important dimethyl-glyoxime or $\alpha$-benzil dioxime methods, although in another part of the book the "cupferron" method for the estimation of iron is described in detail.

The authors give a prominent position to a reference to special British laboratory glass, but no reference is made to the work of the Joint Committee of the Institute of Chemistry and of the Society of Public Analysts and Other Analytical Chemists in publishing and circulating standards of purity for chemical reagents.

The descriptions of processes are for the most part clear and concise, and the underlying principles are well explained. The book is well printed, well illustrated, and is supplied with an adequate index. There is also an appendix containing a good deal of useful information. It may safely be recommended to serious students of analytical chemistry; the others do not matter.

A. CHASTON CHAPMAN.

THE SCIENTISTS' REFERENCE BOOK AND DIARY, 1917. J. Woolley, Sons and Co., Manchester. Price 2s. 6d.

This little reference book and diary is bound in leather with rounded corners, the diary and pencil being detachable.

The Reference Book, consisting of some 130 pages, comprises tables, data, and constants, dealing with nearly 300 distinct subjects. Thus, under the letter P, for example, is included concise information and tabular matter dealing with such diverse subjects as parasitic diseases, the perihelion, periscopic lenses, composition of pewter, physical constants of the elements, human physiology, the planets, population of countries, postal information, potential energy, the poundal, prisms, proteids, and pyramids.

The book is well printed, and the facts so far as they have been tested are accurate and well selected. As a handy little work of reference, it will be found to contain much that is often sought in vain in much larger volumes, while it should prove of distinct use to anyone searching for a diary and reference library combined in one small cover.

H. F. E. HULTON.