

THE ANALYST.

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

ANNUAL GENERAL MEETING AND ORDINARY MEETING, HELD
FEBRUARY 4, 1920.

THE Annual General Meeting of the Society was held on Wednesday, February 4, in the Chemical Society's Rooms, Burlington House, W. The President, Dr. S. Rideal, occupied the chair.

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

Messrs. T. Macara and C. Revis were appointed scrutators of the ballot-papers for election of Officers and Council for 1920.

The Acting Honorary Treasurer presented the accounts of the Society for 1919, and votes of thanks were passed to the Acting Hon. Treasurer and Hon. Secretaries.

Messrs. Marreco, Houseman, and Rixon, chartered accountants, were appointed auditors of the Society's accounts for 1920.

The President delivered his annual address.

Mr. Otto Hehner proposed that a hearty vote of thanks be accorded to the President for his address and for his services in the Chair, and that his permission be asked to print the address in THE ANALYST. This was seconded by Mr. G. N. Huntly, and the motion was carried.

The scrutators having reported the result of their examination of the ballot-papers, the President announced that the Officers and Council for 1920 had been elected in accordance with the Council's nominations, as follows:

President : Alfred Smetham.

Past-Presidents Serving on the Council : Messrs. Leonard Archbutt, Edward J. Bevan, A. Chaston Chapman, Bernard Dyer, Otto Hehner, Samuel Rideal, E. W. Voelcker, J. Augustus Voelcker.

Vice-Presidents : W. J. A. Butterfield, G. N. Huntly, G. R. Thompson.

Hon. Treasurer : Edward Hinks.

Acting Hon. Treasurer : E. W. Voelcker.

Hon. Secretaries : P. A. Ellis Richards, E. Richards Bolton.

Other Members of the Council : Messrs. F. W. F. Arnaud, W. Bacon, F. H. Carr, H. G. Colman, G. D. Elsdon, P. J. Fryer, R. Hellon, H. Hurst, C. A. Keane, S. E. Melling, G. W. Monier-Williams, W. Lincolne Sutton.

An ordinary meeting followed the annual meeting, the newly-elected President, Mr. Alfred Smetham, F.I.C., being in the chair.

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

Certificates were read for the first time in favour of Messrs. Herbert John Evans, B.Sc., F.I.C., Cornelius Durham Garbutt, Henry Atlas, John Carmichael, F.I.C., Maurice S. Hutchinson, B.Sc., Geoffrey Martin, D.Sc., Ph.D., F.I.C., Robert Leitch Morris, F.I.C., James Wood, M.A., B.Sc., F.I.C., Douglas Henville, F.I.C., and Benjamin Richards James, F.I.C.

A certificate was read for the second time in favour of Mr. William John Read, M.Sc., F.I.C.

The following were elected Members of the Society: Messrs. Percy Ewart Bowles, F.I.C., Ph.D. (Heidelberg), Charles Crowther, M.A. (Oxon), Ph.D. (Leipsic), John William Hawley, B.Sc. (Lond.), A.I.C., Ernest Joseph Lush, B.A. (Cantab.), A.I.C., H. Percy Marks, B.Sc., A.I.C., Robert Selby Morrell, M.A. (Cantab.), Ph.D. (Würzburg), F.I.C.

The following papers were read: "An Investigation into the Composition of the Unsaturated Hydrocarbons present in Coal Gas," by F. S. Sinnatt, M.B.E., M.Sc., F.I.C., and L. Slater, M.Sc., A.I.C.; "The Estimation of the Available Oxygen in Sodium Perborate and in Perborate Soap Powders," by H. Trickett, F.I.C.

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OBITUARY.

We deeply regret to record the death on February 7, 1920, of Mr. W. W. Fisher, M.A., F.I.C., a past President of the Society. An obituary notice will appear in a subsequent issue of the ANALYST.

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ANNUAL ADDRESS OF THE RETIRING PRESIDENT.

(Delivered at the Annual General Meeting, February 4, 1920.)

THIS is my valedictory address as your President, and it brings forty-four years of the Society's existence and of the ANALYST to a close. It coincides with the passing of the Local Government Board and the birth of the Ministry of Health.

We began in 1875, a few years after the European struggle of 1870, and are now awaiting the blessings of the new peace which is gradually emerging from, let us hope, the last of these deadly international conflicts.

During the year our Society has progressed, our total number of members to December 31, 1919, including eleven honorary members, is 448 as against 439 for the previous year. We have welcomed twenty-four new members, and have to record the deaths of seven; whilst there have been six resignations from our ranks, and two members have been removed for non-payment of subscription.

The names of the deceased members are: Sir William Crookes (honorary member), John Richard Brooke, Thomas Fairley, Sidney Harvey, George Pilkington, Sir Boverton Redwood, John Charles Umney, and Edward G. Love (New York).

Sir William Crookes was one of the honorary members, and his life work is of world-wide recognition. He published his "Select Methods in Chemical Analysis" in 1871, and stated in his Preface to that work that he had tested most of the processes which had appeared during the previous twelve years in the *Chemical News*, and as some of them had proved of great value, it was thought that a service would be rendered to analytical chemistry if these trustworthy methods of analysis were systematically arranged in a convenient form for laboratory use. There have been few laboratory books which have survived for fifty years. Sir William remarked in 1871 that it was strange that *modern works* on analysis ignored about twenty of the elements, and that even Fresenius at that time only gave a separate form for their detection.

Obituary notices have appeared, in the ANALYST, of Thomas Fairley of Leeds, at one time in this chair as President of the Society, and of Sidney Harvey, a former Vice-President, who also took an active interest in our proceedings. Sir Boverton Redwood was well known in the technology of petroleum, and during his life advanced our knowledge of the methods of testing petroleum and its products.

John Charles Umney, like Sir Boverton Redwood, owed his connection with our Society to his father's pharmaceutical interests, and gave a considerable time to the study of the essential oils.

John Richard Brooke, a Government analyst in Singapore, and George Pilkington were Fellows of the Institute of Chemistry, the latter joining our Society in 1892.

During the session twenty-four papers were read at our meetings, and thirty-two original communications and twenty-seven "Notes" on analytical and kindred matters have been published in the ANALYST. The number of pages is the same as last year—viz., 428.

Titles of papers published in the ANALYST during the year 1919:

- "Estimation of Cacao Shell." By A. Knapp and B. G. McLellan.
- "Estimation of Phenacetin and other Para-Aminophenol Derivatives by Hypochlorous Acid." By A. D. Powell.
- "Effect of Morphine Concentration on the B.P. Method of Morphine Estimation." By H. E. Annett and Hadayal Singh.
- "Methods of Calculating Added Water in Milk." By L. Harris.
- "Fat Extraction Apparatus." By E. Griffiths-Jones.
- "An Instrument for the Determination of Small Quantities of Carbon Monoxide in Hydrogen." By E. K. Rideal and H. S. Taylor.
- "The Use of Ortho-Tolidine as a Colorimetric Test for Gold." By W. B. Pollard.
- "Regeneration of Nessler Solution." By D. Pullman.
- "The Estimation of the Approximate Quantity of Meat in Sausages and Meat Pastes." By G. Stubbs and A. More.
- "The Analysis of Sausages, Meat Pastes, and Army Rations." By A. Stokes.
- "A Combined Method for the Estimation of Small Quantities of Acetone, Alcohol, and Benzene in Air." By Major Elliot and J. Dalton.
- "The Electrical Conductivity of Milk." By J. H. Coste and E. T. Shelbourn.
- "Notes on Soluble Lead in the Glaze of Casseroles." By H. Masters.
- "The Detection and Estimation of Cocaine, Heroine, and Veronal in Viscera." By P. A. Ellis Richards.
- "The Estimation of Small Quantities of Antimony." By W. Beam and G. A. Freak.
- "Estimation of Small Quantities of Lead in Foods and Substances containing Calcium Phosphate." By B. W. J. Warren.
- "Milk Calculations: A Criticism." By H. Droop Richmond.
- "A Method for the Determination of Monochlorbenzene in Mixtures containing Benzene, Monochlorbenzene, and Dichlorbenzene." By N. G. S. Coppin and F. Holt.
- "The Composition of Buttermilk." By T. R. Hodgson.
- "Note on the Oil of *Ceratotheca Sesamoides*." By E. R. Bolton.
- "Studies in Steam Distillation—Part VI.: The Possibilities and Limitations of Duclaux's Methods for the Estimation of Homologous Acids." By H. Droop Richmond.
- "A Rapid Method for Determining Nickel and Cobalt in Ores and Alloys," Part III. By W. R. Schoeller.
- "An Improved Method for the Estimation of Nitrates in Water by Means of the Phenolsulphonic Acid Reaction." By Robert C. Frederick.
- "Mexican Insects in Poultry Food: Mexican Cantharides, *Notonecta*, *Corixa*, and *Berosus*." By T. E. Wallis.
- "Rapid Method for the Estimation of Titanium in Titaniferous Iron Ores." By John Waddell.
- "The Necessity for a Supply of Pure Agricultural Lime." By G. S. Robertson.
- "Milk Calculations: A Reply." By L. J. Harris.
- "Estimation of Morphine in Indian Opium." By Jitendra Nath Rakshi and Frank J. D'Costa.

- “The Examination of Commercial Samples of Nicotine.” By Percival J. Fryer and C. H. Fryer.
- “The Analysis of Brazilian Zirconium Ore.” By A. H. Powell and W. R. Schoeller.
- “The Halogen Absorption of Turpentine.” By Ethel M. Taylor.
- “Egyptian Bricks.” By G. Rudd Thompson.

Three papers emanated from the Ministry of Munitions, four were from India and the Colonies. The paper on the Estimation of Cacao Shell and the two papers on Sausages and Meat Pastes had their origin in attempts made by our members to assist the Ministry of Food to make Food Orders on these subjects workable.

We reviewed twenty-seven new books in the year as against thirty-one in 1918.

I am sure you will agree with me in thanking our editor and his abstracting staff for producing such a readable volume, especially when I understand that the sales of the ANALYST at the increased rate of subscription have been maintained, and that we have therefore a satisfactory balance-sheet from this source. The Publication Committee have already reported to the Council of the Society their satisfaction at the results of this change.

Our Treasurer is at last to be relieved of his war duties. I understand a cable has been received saying that he left Basrah on January 15 in H.M.S. *Rheinfels*, and I am sure we shall all welcome him back.

Our relations with the Institute of Chemistry continue to be of a friendly character. The joint circular letter of January, 1919, sent out by Sir Herbert Jackson and myself to the Clerks of the County Councils, City and Borough Councils concerned with the administration of the Sale of Food and Drugs Acts, and the Fertilizers and Feeding Stuffs Acts, brought in a number of replies which showed that many of the authorities were aware of the peculiar disadvantages which analysts under these Acts were suffering owing to the considerable increase of cost for laboratory work. I am sorry, however, to report that we have still not heard from quite a large number of districts, and it was consequently desirable that a further letter should be sent out again this year. This letter, dated January 16, 1920, was as follows:

“DEAR SIR,

“We are desired by the Councils of the Institute of Chemistry and the Society of Public Analysts to direct the attention of authorities concerned with the administration of the Sale of Food and Drugs and the Fertilizers and Feeding Stuffs Acts to the position, under the prevailing economic conditions, of Public Analysts and Official Agricultural Analysts.

“An impression appears to prevail rather widely that the salaries and emoluments allowed by the authorities are wholly in the nature of profit to the analysts; but this is far from being the case, as the analysts have to meet the cost of maintaining their laboratories and staffs, to pay higher salaries than formerly to their assistants,

and to bear the greatly increased cost of materials and apparatus in addition to the increased cost of living. The salaries of qualified assistants are generally more than double, and the prices for apparatus are about three times, those paid before the war.

"The Councils of the Institute of Chemistry and the Society of Public Analysts understand that some authorities have already taken the prevailing conditions into consideration, and have revised the terms of their analysts' appointments; but the Councils learn that only in very few instances have the analysts' salaries or fees been adequately advanced, while more generous consideration has been given to non-technical officers and employees, whose positions, although they do not necessarily involve the provision of staff and equipment at their own cost, have been similarly affected by the decreasing value of money.

"We may remind you that, under the provisions of the Sale of Food and Drugs Acts, the authorities concerned are empowered to pay Public Analysts such remuneration as shall be mutually agreed upon. Additional payments of the kind suggested can be granted, therefore, without reference to the Ministry of Health.

"We would ask you kindly to bring this letter to the notice of your authorities as soon as possible, and we shall be greatly obliged if you will inform the Registrar of the Institute (30, Russell Square, London, W.C.1) as to the emoluments attaching to the analytical appointments under your authority, and with regard to any modifications which your Council may have made recently, or may contemplate making, in the terms for such appointments.

"Yours faithfully,

"HERBERT JACKSON,

"President of the Institute of Chemistry."

"SAMUEL RIDEAL,

"President of the Society of Public Analysts."

"TO THE CLERKS TO THE COUNTY COUNCILS, CITY AND BOROUGH COUNCILS CONCERNED WITH THE ADMINISTRATION OF THE SALE OF FOOD AND DRUGS ACTS, AND FERTILIZERS AND FEEDING STUFFS ACTS."

The Joint Committee with the Institute of Chemistry has also further considered the question of the inclusion of the Public Analysts in any superannuation scheme. I gave at some length the views which had been arrived at in my Address last year, and now that the report of the Departmental Committee on the Superannuation of Persons employed by the Local Authorities in England and Wales has been presented to the Minister of Health, it is to be hoped that this difficult question will be definitely settled.

The Committee report that it is desirable that a uniform scheme of superannuation should be introduced applicable to persons employed by the local authorities in England and Wales. The scheme is a compulsory one for all Public Analysts not over fifty-five at the commencement of the scheme, and receiving not less than £50 per annum. The part-time Public Analyst is, therefore, definitely included in the scheme.

In assessing the contributions to be paid and the pensions to be received by

part-time officers, it is recommended that "the salary or wages should be the net sum received by the officer for his personal use exclusive of (1) any portion paid to assistants engaged by him, and (2) any travelling and other *expenses* of his office." "Occasional emoluments should be ignored." "Emoluments represented by fees paid to a professional officer on a recognised professional basis should be excluded."

On the other hand, the Committee considered that "the value of all permanent emoluments, which may be defined as any benefits, enjoyed in kind, attaching to an appointment, should be added to the salary or wages, and be definitely fixed by the employing authority on the basis of their value to the holder" (par. 46).

From the wording of the above extracts it seems doubtful if the Committee considered, or even were acquainted with, the widely varying conditions attaching to the appointments of part-time Public Analysts. In any case, these extracts raise some difficult points on which a decision must be come to by Public Analysts: Should a Public Analyst (part time) be pensioned on the basis of the actual fees or salary paid him, or should a deduction be made for his working expenses? If the latter, how is the amount of that deduction to be determined?

The provision for retirement at sixty, after forty years' service, to be optional on either side, obviously leaves the final decision as to whether the officer shall continue at work with the local Authority after the age of sixty if the parties are not agreed—*i.e.*, the officer can retire at sixty if he likes, but he cannot continue in office unless the Authority agree to let him.

In the case of officers not entitled to superannuation who have to retire, the provision for the return of their contributions with only 3 per cent. compound interest is hardly just, and certainly not liberal. A sliding scale of pension to reach the maximum after ten years' service would obviously be much fairer.

Where retirement takes place owing to the abolition of office full compensation should be granted, as was done in the case of the London Government Act, 1899.

In the case of voluntary retirement the return of contributions without any interest whatever is altogether unfair.

The exclusion of officers of fifty-five years and upwards, although justifiable from an actuarial point of view, will be a great disappointment to many, and if a bill embodying the scheme in its present form should be introduced into Parliament, steps should be taken to amend it in this connection, and also as regards the failure to recognise any claims in respect of "back service"—*i.e.*, past service at the time the scheme comes into force. The power given to the authorities to grant compensation or superannuation in such cases if they like is of very little value. It is probable that they have this power already, and in any event they would be extremely unlikely to exercise it in the case of a part-time Public Analyst.

The Joint Committee has also under consideration the question of revising and extending the A.R. list of reagents for analytical purposes published in 1915.

A Standards Committee has also been formed from representatives of our Society and that of the Institute of Chemistry, with members of the Society of Chemical Industry and the Institute of Metals, to consider the proposal of preparing and issuing standard alloys and like substances for future reference, which might be useful for arbitration purposes, or in cases of doubt or dispute.

We have delegated Mr. Huntly to represent the Society on a committee of the Imperial Mineral Resources Bureau, which has had several meetings during the year, and is engaged on the important inquiry as to how the scientific and technical information required for the development of our mineral resources can best be disseminated. The preparation of a general card index of the books and periodicals relating to the mining and metallurgical industries available in London and Newcastle is under discussion, and some pooling of abstracts of papers is being considered.

I have, during the past year, continued to represent this Society at the meetings of the Conjoint Board of Scientific Societies, and of the Federal Council for Pure and Applied Chemistry. Both of these bodies have had several important matters under consideration, amongst others, as you are aware from an informal report I brought to your notice at one of our sessional meetings on the proposal to develop the Metric and Decimal Systems in this country. This matter has been referred back, so there is at present nothing to report in connection with this proposal.

In my address last year I referred to the activity of the Department of Scientific and Industrial Research and its bearing on the scope and work of our members.

The Food Investigation Board has now published its report for the year 1918, and in it they point out that their field of work is distinct from that of the Medical Research Committee, the Development Commission, and of the Public Health Department of the Local Government Board, under which those of our members who hold Public Analyst appointments formerly worked.

At the same time, in the first year of work they appointed committees at the request of the Ministry of Food on matters which ultimately concern us in our official duties, such as a survey of the sources of the supply of edible oils and fats, with the object of increasing the proportion available for human consumption, and a sub-committee is at work on the problem of the evaluation of a definite chemical standard of quality which, if it can be evaluated, would be of great use in our work, and in addition, the Ministry of Food have referred to the special questions of the distribution of accessory foodstuffs (vitamines) in edible fats of various origin and the presence of traces of nickel in hardened fats. I gather that the Medical Research Committee is also engaged on research on accessory foodstuffs, and that the two committees are working in accord.

The terms of reference of the Oils and Fats Committee require them to consider and report upon :

1. The treatment of inedible oils and fats necessary to fit them for human consumption.
2. The production of glycerol from some sources other than naturally occurring esters.
3. The provision of suitable substitutes for animal and vegetable oils and fats now used in commerce.
4. The purification and digestibility of fatty acids.
5. The effect of storage and methods of treatment of fats on the fat-soluble accessory foodstuffs, and an edibility test conference has been set up to formulate a set of standards for the more common edible oils and fats, including (a) colour, (b) test of free acidity, and (c) tests for oxidation and rancidity; but excluding the question of "bouquet."

Meantime war emergency can be pleaded for the definitions of edible and inedible fat issued by the Food Controller under the order of June 12, 1918, but it would have been difficult to prove that more than 1 per cent. of water and impurities, or more than 2 per cent. of free fatty acids, ceased to make a bone fat or dripping edible, and even last year on May 30, 1919, the Food Controller seems to have taken the power to say what an oil or fat compound (other than a margarine or vegetable butter) may consist of without giving us any indication how their suitability for human consumption shall be determined; the only practicable tests under the order being now that it shall contain no other commodity (whatever that may mean) and not more than 0·5 per cent. of free fatty acids and 0·5 per cent. of water and impurities taken together. Under the same order *margarine* must now contain only such ingredients as the Food Controller may prescribe, and at least 80 per cent. of oil and fat. It might be desirable in this connection for the Ministry of Health to ask the Food Controller to prescribe the presence of the fat-soluble accessory food factor.

Vegetable Butter is now 75 per cent. of refined, deodorised vegetable oil and 25 per cent. of nut cream and no other ingredients, and yet, up to the time of sale, it may contain up to and no more than 2·5 per cent. of water.

Shredded Suet is now defined as (1) at least 80 per cent. of fat, premier jus or premier jus and beef stearine; (2) not more than 2·5 per cent. of water, and the balance hard grain rice flour, and no other commodity.

As a matter of fact I was not officially informed of this order, but by the end of October, by inquiring of the Director of Oils and Fats Branch of the Ministry of Food, I obtained a copy.

The Ministry of Health, which had been in existence for several months, could not give me any information on the subject, but informed me that there was no legislation so far as their Department was concerned, so that we may take it that the Ministry of Health is not at present engaged on the subject. It is surprising that the Ministry of Food issued these orders whilst they were themselves inquiring from the Food Investigation Committee of the Privy Council for information as to the wisdom or scientific justification of such legislation.

We thus see that certain subjects which our own Analytical Investigation Scheme was founded to cover are being dealt with under the ægis of the Privy Council, and we hope that these reports will give the Ministry of Health the information which will enable us to exercise in our official work a greater and more effective control of the food of the people.

There is, however, plenty of work for our scheme, several interesting researches are now being prosecuted by our members, and, as I pointed out last year, some fifty original investigations initiated by your Committee have already been published in the *ANALYST*.

One communication under this scheme is being made to the Society to-night by Mr. Trickett, and we hope to receive others at an early date.

In December last, a number of our members had an informal discussion with the members of the Agricultural Education Association with regard to the different methods of estimating crude fibre in feeding-stuffs, and from what passed it would

appear that there is room for further research in order to attain a greater uniformity in the results obtained by different methods. A proposal has been made that this matter should be investigated under the Analytical Investigation Scheme* (ANALYST, 1914, 39, 337-340), and a subcommittee has been appointed to decide upon the line the inquiry should take. The Hon. Secretaries will be pleased to receive further suggestions as to subjects for research.

By far the most important event in the year has, however, been the establishment of the new Ministry of Health. In the negotiations before this new Government Department came into being, Sir Herbert Jackson and myself, as your President, addressed a letter in March last to Dr. Addison, which was published in Part III. of the Proceedings of the Institute of Chemistry in July last, urging adequate representation of our profession on the Advisory Committees, and eventually the Institute was asked to nominate two representative chemists. Unfortunately, the Ministry have retreated from their original invitation, and now only one chemist, Sir William Tilden, F.R.S., is in charge of the various interests which Public Analysts have now and in the future to carry out.

Dr. F. Gowland Hopkins, F.R.S., and Dr. T. Eustace Hill, O.B.E., are also, however, members of the Council on Medical and Allied Services, and will be interested in our branch of public health work.

A deputation from the Association of Public Analysts of Scotland urging similar claims in connection with the Scottish Board of Health Bill was received by Mr. Robert Munroe, K.C., M.P., the Secretary for Scotland, on May 3, and an account of our meeting, which I, as your President, and Mr. P. A. Ellis Richards attended, is also recorded in the Proceedings of the Institute.

As a result of this effort, up to the present time all that has happened is this: The Association of Public Analysts of Scotland were asked by the Scottish Board of Health to nominate two members for the Medical and Allied Services Committee which is to advise the Board. As the result of that nomination, the Scottish Board of Health wrote to Dr. Tocher and asked whether he would be willing to join the Committee, and thus the profession has now only one nominee there as in England. I am sure that if he gets the opportunity he will raise the question of amending the Sale of Food and Drugs Acts, and will also press for the appointment of an Official Chemical Adviser, or expert, on the Scottish Board of Health.

June, 1919, brought about the termination of the Local Government Board as a Department of State and the consequent transference of our duties as Public Analysts appointed under that Board to the new Ministry of Health.

The routine work of the Inspectors of Foods under that Board on such matters as the administration of Unsound Food and Foreign Meat Regulations, Sale of Food and Drugs Acts, and other measures dealing with food, is now transferred to the new authority. The last report deals with a large number of special questions arising out of the abnormal conditions of food supply. Especially with regard to imported frozen meat, inquiries were held at several provincial towns and complaints in-

* A reprint of the report of the Analytical Investigation Scheme may be obtained on application to the Hon. Secretaries of the Society.

vestigated, and found to be chiefly confined to matters arising out of unsuitable methods of conveying meat by rail.

Dr. McFadden also draws attention to the liability of certain articles used in the preparation of foods to become contaminated with arsenic, but reports that no recurrence of the circumstances of two years ago have been noted. He still considers that baking powder materials are liable to suspicion, and thinks it desirable that Public Analysts throughout the country should continue to keep food materials of this class under observation locally. The antimony found in self-raising flour at Manchester was attributed to accidental bulk contamination of a limited amount of flour or of the ingredients used.

Imported tinned fruits arrived into this country under suspicion of having been maliciously infected with pathogenic bacteria, but these allegations were found to be false.

Christmas puddings and tinned meat intended for the troops were also under similar suspicion, the former bearing no evidence of unwholesomeness either culturally or as the result of feeding experiments on monkeys; but some of the tins of meat were blown.

The Government Chemist, in his Annual Report (see p. 113), states that 97 samples were referred by magistrates as against 102 in the previous year. The results of these differed from those of the Public Analyst in only twelve cases. Eighty-two of the referred cases were samples of milk.

The importance of proper inspection of home-killed meat is somewhat out of the scope of our duties, but the Public Analyst might be required to issue a certificate as to whether meat derived from a diseased animal or in an unwholesome state is of the nature, quality, and substance demanded.

In 1898 the Royal Commission on Tuberculosis recommended the closure of private slaughter-houses, but up to the present only about 100 local authorities have public abattoirs; and during the war the Ministry of Food have, under an order of that Department, made themselves responsible for the grading of cattle and their subsequent slaughter in licensed houses, and the late Local Government Board arranged for the inspection of all fourth-grade cattle killed at those slaughter-houses by the Medical Officer of Health of each district concerned, but the position in regard to this matter from the Public Analyst's point of view is most unsatisfactory. Supervision of places where food is prepared or kept for sale for human consumption was developed as a war necessity by the power given for this supervision in the contracts entered into between the Government Departments and the various food contractors, and in this way factories and other places where food is prepared or kept for sale, if carrying out a Government contract, were under supervision as to hygienic surroundings and suitability and cleanliness. This supervision will no longer obtain when Government contracts are at an end.

I hope that the improvements brought about in this way by the war may be maintained even without further powers than those already possessed by the local authorities under the Public Health Acts. Early in the year we had a discussion and two interesting papers on the "Analysis of Sausages, Meat Pastes, and Army

Rations," which show how difficult it is to ascertain whether these are made of pure and wholesome foodstuffs.

There is a growing demand for cooked and preserved foods of all kinds, especially in the poorer and in manufacturing districts. The coal shortage and high prices indicate that the number of premises where food is prepared or cooked for sale will increase, and in the absence of any fresh regulations for this class of premises, the examination and control of cooked foods under the Sale of Food and Drugs Acts becomes more and more important; whilst the difficulties of definition and the routine examination for bacterial contamination by flies, the presence of the droppings of rodents and the like, and ptomaine poisoning, renders the work of the analyst more exacting.

The Food (War) Committee of the Royal Society has brought vividly before the authorities several problems on human nutrition, which bear forcibly upon the value of food analysis in determining the nation's dietary. The energy value of foods, the relative value of the proteins, carbohydrates, and fats, and their digestibility in different forms, have all an important bearing on the question; but it is doubtful whether our knowledge of these factors is yet sufficiently advanced for these to be included in standards to be complied with which can be controlled under the Acts.

The vitamins are known to play an essential part in nutrition, yet we have no ready means of determining whether a given sample is deficient or not in these all-important constituents.

I have already mentioned that the Food Investigation Board has undertaken to elucidate this matter with regard to edible fats, although the Medical Research Committee, in their special report, No. 38, have shown that fats, like butter and cod-liver oil, contain the fat-soluble A vitamin, which insures normal growth, and the absence of rickets and defective teeth in children, but that it is absent from hydrogenated vegetable oils, and, consequently, a margarine containing no animal fat is probably deficient in food value.

The embryo of cereals and pulses also contains an antineuritic vitamin, which is water-soluble, and is absent from the white flour of the new peace bread, but was present in the war bread of 80 per cent. milling and in wholemeal.

The polishing away of the bran and embryo of rice removes its vitamin, and is known to have accentuated the spread of beri-beri in the East, and dangers of a like kind may be lurking in many of the modern methods of preserving food.

Last year I pointed out that your officials had drawn the attention of the Ministry of Food to the impossibility of insuring a scientific control of the orders which were then being issued in regard to bread and flour; but now that there is a definite Government policy of subsidising the bread of the people by £50,000,000 per annum, it should be possible at any rate to limit the quantity of water which a loaf of bread should contain. There is at least 5 per cent. variation in the amount of water from different bakeries, and seeing that an adulteration with water of milk to this extent now usually insures a heavy penalty on conviction, I do think that in this, the most important of our foods, we should at least expect to get food of standard quality and purity.

A loaf of bread is sold by weight; 5 per cent. additional water in a loaf would enable a given supply of wheat to supply additional loaves to last the country another fortnight, but would not increase its food value. This session it is proposed to legislate the sale of gas by heat units; is it too much to ask that the controlled price of the subsidised bread should be based upon its calories or food value?

The experiments carried out by the food (war) committee of the Royal Society on the digestibility of breads give us definite information on subjects which, but for the war, would probably have been left alone.

The experiments were undertaken for the purpose of showing whether the more economical milling of flour (from a 70 per cent. to a 90 per cent. basis) would have any deleterious effect on the health of the population and how it would be received by the people should the necessity arise for supplying it.

The experiments showed that in two mixed foods containing 50 per cent. of their calories in bread, the one made up with the 90 per cent. flour contained 93.4 per cent. utilisable energy and 87.4 per cent. utilisable nitrogen, while that made up from the 80 per cent. flour, 96.14 per cent. energy, and 89.4 per cent. nitrogen.

Further experiments showed that individuals fed on the 90 per cent. flour retained on the average 0.71 gm. nitrogen per day, while those fed on the 80 per cent. flour, 1.96 gm. All individuals expressed a liking for the 90 per cent. bread.

Previous experiments have shown that the digestibility of husk is increased if it be ground to a fine state of division. In these experiments the fine husk was added to the flour and the bran was quantitatively recovered by sieving with No. 7 silk (80 meshes per linear inch), and the separation formed a check on the milling. Evidently the process can be used to identify various grades of flour, and there can be no doubt that fineness of division is an important factor which might easily be standardised and thus be controllable under the Acts.

Experiments with flour containing 20 per cent. maize and ordinary wheaten flour revealed the fact that the percentage of available energy and available nitrogen was the same for both, but that the bread made from maize flour was at first difficult to swallow and was the cause of various symptoms which disappeared after a few days.

Further work on vitamins has shown that they are destroyed when fresh foods are submitted to such processes as desiccation or concentration even under reduced pressure. Simple hydrogenation of vegetable oils produces a similar result.

The antiscorbutic vitamin of fresh vegetables is destroyed by drying or by prolonged cooking so that vegetables when desiccated or tinned even in the absence of preservatives have not the food equivalent of the fresh article.

Unfortunately no routine methods of analysis have yet been devised to test their absence in foods, although from time to time methods have been advanced with that object in view. Thus Thompson (*J. Agric. Research*, 1915, 3, 425-429) found that phosphoric acid was present in organic combination with inositol or phytic acid in the seeds of many plants, and that in the case of rice the total phosphorus in the bran was 2.29 per cent., in polished rice 0.14, and in unpolished rice 0.32. Phytin itself determined by extraction with 0.2 per cent. HCl, and after precipitation with alcohol was present to the extent of 8.2 per cent. in bran but could not be obtained from

polished rice. The necessity for the proper examination of rice for facing materials is shown by the recorded case of a calculus which was obtained from a person very fond of rice and which had a composition very similar to the steatite found on the rice which he had been accustomed to consume. (ANALYST, 1910, 35, 479.)

With reference to the proposal of a standard for cheese I am sorry to say that so far no progress has been made. Irish makers who turned out 14,000 tons of cheese last year are unanimous in asking for a standard of 45 per cent. of fat in the dry matter for whole-milk cheese, and 35 per cent. of fat in the partially skimmed cheese. The Irish Department of Agriculture endorse these figures. On the other hand, the Scottish Board of Agriculture would like to see a standard of 50 per cent. of fat in the dry matter for whole milk cheese, while the English Ministry of Agriculture consider that their makers must be educated up before any action could be taken. The question has been somewhat complicated by the desire to set up standards for condensed milk. Some conferences were held with the trade on this latter subject and the following standards were agreed to :

Condensed Whole Milk.—Total milk solids not less than 30 per cent., made up as follows : Solids-not-fat, 21 per cent. ; fat, 9 per cent. ; added sugar not to exceed $42\frac{1}{2}$ per cent.

Condensed Separated Milk.—Total milk solids not less than 26 per cent. ; sugar not to exceed 46 per cent.

It is found, however, that the legal advisers are of the opinion that under Section 4 of the Sale of Food and Drugs Acts, 1899, the Ministry of Agriculture had no power to set up standards for condensed milk, and the matter has been referred to the Ministry of Health for action. I wonder for how long?

I think if our Society were to lend its support to the demand for standards for all milk products, and to press this demand on the three Boards of Agriculture for England, Scotland, and Ireland, and also the Ministry of Health, something might be done.

At present the honest trader is at the mercy of the dishonest trader when marketing his cheese or condensed milk. Unlike the old question of butter and milk standards, the demand for standards is being pressed forward by the manufacturers, and although in many cases the fixing of standards has resulted in deterioration or degeneration, on the whole they work for uniformity and minimise disputes.

I have recently, in my own practice, had occasion to form an opinion on milk powder. This, as you know, forms an ingredient in proprietary foods, but whether a solid milk powder has chemical properties as to nature, quality, and substance of the milk from which it is derived, I find no binding authoritative statement.

I submit that Dr. Coult's suggested limits for the quantity of fat in full-cream and half-cream milk powders might be made known to infant welfare centres and children's homes, and that the local authorities should be pressed by the Ministry of Health to ascertain how far, in these days of dear milk, these milk powders are being used, and what is the nature and quality of the supply.

Drug samples are seldom submitted by local authorities to their analysts. Tabulated returns for the last few years are not available. In my own case I find that out of 5,619 samples examined during the last fourteen years only one drug was included.

I understand that in Lancashire, under the instructions of the Ministry of Health, drugs used for National Health Insurance dispensing are being examined under the Acts as follows :

The Medical Officer of Health, with the analyst, writes a set of prescriptions, hands them to the clerk to the Insurance Committee, and he asks doctors (five or six) from different localities to order them. These are brought in by a boy, saying he would call later on. The boy returns, and when told the medicine is ready, walks out and informs the inspector, who then comes in. The inspector divides the sample in the usual manner after paying for the medicine. Then he hands over a copy, requesting the druggist to stamp it. He keeps the copy and initials the original, which he hands back to the druggist. In about ten days postcards are sent out by the analyst that the sample need no longer be kept (this is done at the request of the Pharmaceutical Committee), while in some cases the medical officer writes that the medicine is deficient by so much per cent., and warns the druggist that prosecution will follow if deficient on another occasion.

The Medical Research Committee has also reported to the Ministry of Health on the subject of testing venereal drugs, and the following are the suggested standards for salvarsan and neosalvarsan :

SALVARSAN.

Physical Properties.—The drug should be in the condition of a pale yellow to yellow amorphous powder, freely mobile in contact with glass surfaces, and practically without odour, except that due to traces of ether.

Ash.—On ignition the yield of ash should not be more than 0·5 per cent.

Solubility.—If 0·5 gm. of the powder is added to 35 c.c. of distilled water contained in a glass-stoppered 250 c.c. cylinder and the contents vigorously shaken, the powder should rapidly and completely dissolve. The solution should be neutral to Congo red paper, and should be of a pale yellow colour, perfectly clear and free from flocculi, hairs, dust, or suspended particles of any kind. The addition of 1 c.c. of 15 per cent. sodium hydroxide to the aqueous solution should cause a preliminary separation of the solid arseno-base which, on shaking the liquid, should completely dissolve, forming a bright yellow solution. This, on dilution to 250 c.c. with 0·5 per cent. saline solution, should give a perfectly clear bright light yellow liquid.

Percentage of Arsenic.—The powder, as taken directly from the tube, should not contain less than 30 per cent. nor more than 34 per cent. of arsenic, as determined by some absolute method.

NEOSALVARSAN.

General Properties.—Neosalvarsan should be a yellow to orange-yellow fairly dense dry powder, mobile in contact with glass surfaces, and practically without odour except that due to traces of alcohol and ether ; its aqueous solution (5 per cent.) should be neutral to litmus paper.

Solubility.—If 0.6 grm. of neosalvarsan be added to 1 c.c. of water, it should dissolve rapidly and completely, forming a yellow-coloured solution, mobile, non-gelatinous, and free from suspended particles.

Percentage of Arsenic.—Neosalvarsan should contain not less than 18 per cent., and not more than 21 per cent., of arsenic. The methods of estimating the arsenic—the oxidation titration method and the gravimetric assay as magnesium pyroarsenate—are given in an appendix to the report. Biological tests are also dealt with, and it is pointed out that fresh legislation should be obtained making the Ministry of Health responsible for controlling the conditions under which such toxic drugs are supplied, and that the department should make regulations prohibiting the import and sale of the drugs unless they comply with certain stipulated chemical and biological tests.

I think that it is in one way unfortunate that so many departments are now interested in these questions, as it makes it difficult for the Public Analyst to follow the various orders and regulations which are issued, and still more at a loss to deal with what does or does not constitute adulteration or what is or is not to be regarded as injurious to health. For many years we asked for a Committee of Reference, and in our recent memorials in connection with the Ministry of Health the most urgent matter for consideration has been the want of instruction or guidance shown by the several departments in the matter of standards of purity which could assist us in our work.

Passing from a consideration of food and drugs, I am glad to be able to record that one of the first acts of the Ministry of Health has been to appoint a chemical and bacteriological inspector in the person of Dr. Calvert, for many years with Dr. Maclean Wilson of the West Riding Rivers Board. This new inspector will assist the Ministry of Health in connection with the duties involved, under the Rivers Pollution Acts, and in inquiries in relation to sewage disposal cases. Let us hope that the appointment indicates that the Ministry of Health will follow up the work of the Royal Commission on Sewage Disposal which was closed down by the Local Government Board owing to war conditions, but which has paved the way for the promotion of economical methods of sewage disposal and the prevention of the present national nitrogenous waste which obtains in most of the schemes sanctioned in the past.

I must apologise for the length of my address. I thank the officers for their assistance during my term of office and the Society for electing me to this chair, and I now have pleasure in welcoming your new President, Mr. Alfred Smetham.



AN INVESTIGATION INTO THE COMPOSITION OF THE UNSATURATED HYDROCARBONS PRESENT IN COAL-GAS.

BY F. S. SINNATT, M.B.E., M.Sc.(TECH.), F.I.C., AND L. SLATER,
M.Sc. (TECH.), A.I.C.

(Read at the Meeting, February 4, 1920.)

COMPARATIVELY little information appears in the literature dealing with the composition of the unsaturated hydrocarbons occurring in ordinary coal-gas. No very recent analyses are available, and it may therefore be of some interest to place on record the results of an investigation carried out in June and July, 1914. Military duty has prevented the completion of the original investigation, but it is felt that the facts may be of some use to chemists dealing with the analysis of coal-gas, especially those who calculate the calorific value of the gas from the results obtained by chemical analysis. It is a common opinion that the calorific value of gas obtained by calculation from the analytical figures is probably quite as accurate as that obtained by the determination in a calorimeter. One of the chief sources of error in the calculated value lies in the fact that the exact composition of the unsaturated hydrocarbons is not known, and consequently the calorific value of these constituents is generally computed. The values given in this paper show that over two periods of about three weeks the composition of the unsaturated hydrocarbons present in a normal town's gas (Manchester) was practically constant, and it may be assumed, with a certain amount of reason, that coal-gas from other sources would yield very similar results.

In order to be able to elaborate a method for the extraction of the unsaturated hydrocarbons from the gas, it was necessary to ascertain whether bromine would absorb the hydrocarbons if the coal-gas were simply aspirated through it. In gas analysis it is usual to treat the gas a number of times with the reagent, in order to bring about complete absorption. Coal-gas was aspirated, at the rate of 10 litres per hour, through a series of three washing bottles, each containing bromine covered with water; the depth of the bromine was about $\frac{3}{4}$ inch, and the water about 1 inch. The first two wash-bottles were cooled in water, the last ice-cooled. When 50 litres of gas had passed, the liquid in each bottle was treated with dilute caustic soda solution to remove the excess of bromine, and the bromine compounds of the unsaturated hydrocarbons were separated. It was found that the third washing-bottle contained no liquid bromine compounds at all, whilst the second bottle contained only a small volume, indicating that the unsaturated hydrocarbons were practically completely absorbed by the bromine in the first bottle. Three washing-bottles were therefore connected to a meter, and coal-gas aspirated first through the meter, care being taken to insure the liquid in the meter was saturated with the coal-gas before commencing the actual determination. It was necessary to attach an aspirating pump to the outlet of the last washing-bottle, to overcome the pressure of the liquid in the washing-bottles. The rate at which the gas was aspirated through the bromine was about 10 litres per hour, and the experiments ran continuously from 9 $\frac{1}{2}$ a.m. to 5 p.m. for ten days in the first test, and three weeks in the second test.

The rotation of the wash-bottles was changed when the first one had become practically saturated, and fresh bromine was placed in the last. By this means, the complete absorption of the unsaturated hydrocarbons was assured. The bromine from the first wash-bottle was collected in one vessel, until the experiment was complete, and was then treated with a very dilute solution of caustic soda; it was washed repeatedly with small volumes of water, and the colourless bromine compounds of the unsaturated hydrocarbons were allowed to stand over anhydrous potassium carbonate until completely dry. The liquid was finally filtered through dry filter-paper. Throughout the above operations the temperature of the liquid was kept as low as possible in order to prevent excessive evaporation.

The liquid was subjected to distillation under a pressure of 15 mm., and the distillates collected at the following temperatures: up to 100° C., and from 100° C. to a point where decomposition occurred (145° to 150° C.). The distillate collected below 100° C. (15 mm.) was distilled under a fractionation column, and yielded the following results:

	First Experiment.	Second Experiment.
Total weight of liquid obtained	235 grms.	520 grms.
<i>Fraction</i> °C.—		
Up to 125	4.4	17.1
125 to 135	141.7	280.5
135 to 145	24.4	42.3
145 to 165	3.4	9.0
165 to 195	2.0	6.3
Residues from both distillations not identified, but containing dibrombenzene	59.1	164.8
Volume of gas	700 litres.	1,600 litres.

The residue remaining from the distillation under reduced pressure, and the redistillation under ordinary pressure, was not investigated, beyond proving that the chief constituent was dibrombenzene (m.p. 87° C.).

Fraction °C.	Chief Constituent.
Up to 125	A mixture of benzene and toluene, and a small percentage of heptane.
125 to 135	Ethylene dibromide, b.p. 130.3° C.
135 to 145	Propylene dibromide, b.p. 141.5° C.
145 to 165	Butylene dibromides, b.p. 148° to 166° C. (brombenzene could not be identified).
165 to 195	Amylene bromides, b.p. 172° to 178° C.

The whole of the above compounds, and also the hexylene bromides, boil practically without decomposition below 100° C. under a pressure of 15 mm.

Acetylene tetrabromide, which is formed by the action of bromine upon acetylene,

has a boiling-point of 114° C. at 12 mm. pressure, and could not therefore be present in the distillates obtained during these experiments, where the limiting figure was 100° C. at 15 mm. pressure. The dibromide of acetylene is not formed by the action of concentrated bromine upon acetylene. It is clear, therefore, that the only compounds which have been separated by the treatment described in this paper are the members of the ethylene series.

The percentage composition by volume of the unsaturated hydrocarbons (to the first decimal) present in the gas, calculated from the weight of dibrom compounds obtained, is as follows :

	First Experiment. Percentage by Volume.	Second Experiment. Percentage by Volume.
Ethylene	83·8	84·3
Propylene	13·4	11·8
Butylene	1·7	2·3
Amylene	1·0	1·5

Repeated determinations of the actual percentage of unsaturated hydrocarbons in the coal-gas were carried out during the progress of the experiments, using fuming sulphuric acid as the absorbent, and the amount varied between the limits of 3·5 and 4·5 per cent. It is evident from the values found, that although the actual composition of the unsaturated hydrocarbons showed comparatively little alteration, the proportion of benzene, toluene, etc., to unsaturated hydrocarbons in the gas, must have varied considerably during the course of the experiments. If other experimentors wish to carry out similar determinations, it may be suggested that it would be advisable to eliminate the aromatic hydrocarbons, before attempting to absorb the unsaturated hydrocarbons in bromine. The fraction from 100° to 140° C. (15 mm.) became solid on being allowed to stand. It was not completely investigated beyond finding that its melting-point was 87° C., and that the main compound present was dibrombenzene.

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DISCUSSION.

Mr. CHASTON CHAPMAN remarked that he was rather surprised that it had been found possible to estimate by a method depending on the separation by fractional distillation under reduced pressure of their mixed bromides, four adjacent homologues such as ethylene, propylene, butylene and amylen, with the degree of accuracy suggested by the figures the authors had given. The boiling-points of the bromides in question were not very far removed from one another, and apart from any interference due to the presence of unsaturated hydrocarbons belonging to other series, he would scarcely have expected that such a method would have been capable of giving quantitative results.

Mr. H. G. COLMAN said that the method adopted by the authors—namely,

extracting the unsaturated hydrocarbons by bromine and fractionation of the resulting bromides—did not seem likely to give any definite information with respect to the unsaturated hydrocarbons present in only small quantity. Undoubtedly the nature and relative amounts of the various unsaturated hydrocarbons varied very greatly according to the temperature and other conditions under which the coal was carbonised, and still more in the case of gas made from oil. In all cases olefines formed the largest proportion of such hydrocarbons, but varying amounts of dienes, acetylenes and cyclo-dienes were always present.

So far as the constituents having five or more atoms of carbon are concerned, the most promising material for their investigation appeared to be the crude benzol obtained by washing coal-gas with oil, which always contained these hydrocarbons in considerable quantity.

* * * * *

THE ESTIMATION OF THE AVAILABLE OXYGEN IN SODIUM PERBORATE AND IN PERBORATE SOAP POWDERS.

By H. TRICKETT, F.I.C.

(*Read at the Meeting, February 4, 1920.*)

Of the many methods that have been proposed for the estimation of the available oxygen in hydrogen peroxide and sodium peroxide, most are applicable to the valuation of sodium perborate, and the volumetric determination, either with potassium permanganate (1) (Jaubert, *Comptes rend.*, 1904, 139, 796), or with potassium iodide (2) (Kingzett, *J. Chem. Soc.*, 1880, 792; Carpenter and Nicholson, *ANALYST*, 1884, 9, 36), is generally regarded as the most accurate. Since some determinations by these methods were found to give varying results, it seemed of interest to examine the conditions necessary to obtain concordant data, especially as a basis for a method of estimating the perborate contents of soap powders and similar products.

As the initial material for these experiments a sample of sodium perborate was employed, which gave the following results upon analysis:

	Found.	Calculated for NaBO ₃ 4H ₂ O
H ₂ O	45·42 per cent.	46·78 per cent.
Na ₂ O	20·61 „	20·12 „
B ₂ O ₃	24·21 „	22·72 „
O ₂	9·62 „	10·38 „
Iron and chlorine	... traces.	

The values obtained indicate that the sample did not contain the full proportion of water of crystallisation. The value for the available oxygen was the mean of a number of estimations by the potassium iodide method given below.

The following methods for the estimation of the available oxygen were examined:

1. ESTIMATION BY POTASSIUM PERMANGANATE.

The permanganate method of estimation was examined by: (a) Titrating back the excess of permanganate with oxalic acid; (b) direct titration; (c) gas volumetric estimation.

(a) In this case a known weight of the perborate was washed into an excess of $\frac{N}{10}$ potassium permanganate, acidified with concentrated sulphuric acid sufficient to give a 15 to 20 per cent. solution on the final volume. The excess of permanganate solution was titrated at about 70° C. with $\frac{N}{10}$ oxalic acid. The estimation was carried out with the solid perborate, in order to test the applicability of the method to the direct estimation of perborate in soap powders. The results were rather irregular, and out of seven determinations the available oxygen value varied between 8.26 per cent. and 9.46 per cent.

(b) In the direct titration about 20 c.c. of $\frac{N}{10}$ potassium permanganate were acidified with varying quantities of sulphuric acid, and titrated with a 0.5 per cent. perborate solution at varying temperatures. It was found that direct titration gave irregular results, owing to the end-point being rather indefinite. This difficulty was easily overcome by the addition of a slight excess of the perborate solution, and titrating back with potassium permanganate. Increase in temperature and in the concentration of sulphuric acid tend to give too high results.

The most favourable conditions indicated are—

(1) Temperature for titration of permanganate, 15° to 20° C. (2) Concentration of about 5 per cent. of sulphuric acid on the total volume.

The results obtained under these conditions were somewhat low but consistent; a series of estimations gave the following results: 9.39, 9.51, 9.45, and 9.46 per cent. available oxygen as compared with 9.62 per cent. obtained by the iodide method to be described below.

Milbauer (*J. Prakt. Chem.*, 1918, **98**, 1-8) recommends the introduction of boric acid to permanganate titrations of hydrogen peroxide in order to prevent the catalytic decomposition of the latter by the $MnSO_4$ produced in the reaction. Although boric acid was present in these solutions, it was probably not in sufficient quantity to prevent some loss of oxygen in the method.

(c) The gas volumetric method for the valuation of perborate by means of acidified permanganate has been proposed by Bosshard and Zwicky (*Zeitsch. angew. Chem.*, 1910, **23**, 1153-1154; *ANALYST*, 1910, **35**, 372) and others. The results obtained were, however, very irregular, and showed variations of from 1.5 to 2 per cent. in the available oxygen. The method is rapid, but too unreliable even for approximate determinations. Cf. Archbutt (*ANALYST*, 1895, **20**, 4).

2. ESTIMATION BY MEANS OF POTASSIUM IODIDE.

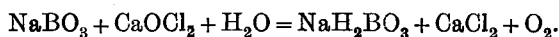
In this method, as is well known, the perborate solution is added to acidified potassium iodide solution, and the liberated iodine titrated with sodium thiosulphate, using starch as an indicator. Unless sufficient free hydrochloric acid is present, the decomposition proceeds very slowly. An acidity of 10 per cent. hydrochloric acid on the final volume gave the best results, and allowed of the completion of the titration

in twenty minutes. It was also found advantageous to proportion the concentration of the potassium iodide and sodium perborate solutions at 40:1, and to adjust the volume of the potassium iodide solution so as to give a final concentration representing about 1 per cent. of potassium iodide. The following data typically indicate the concordant results obtained: 9.65, 9.61, 9.62, and 9.60 per cent. available oxygen.

3. GAS VOLUMETRIC ESTIMATION BY HYPOCHLORITE.

Although the iodide method as described above is quite reliable, it is less rapid than a gas volumetric method, and in the case of soap powders and the like, the previous removal of the soap, etc., is necessary.

It was from this standpoint that experiments were carried out to ascertain whether satisfactory results could be obtained by decomposition of a perborate with hypochlorite on the lines of the corresponding reaction with hydrogen peroxide:



The method adopted was as follows: About 0.2 gm. of sodium perborate was mixed with about 20 c.c. of water in a beaker, the coarser lumps crushed, and the whole thoroughly wetted. The mixture was then transferred to the outer vessel of a nitrometer decomposition bottle, and the inner vessel filled with a clear saturated solution of bleaching powder—about 15 c.c. The determination was carried out with the usual precautions, and the volume of oxygen measured after five minutes' intermittent shaking of the reaction mixture. The following results were obtained on the original sample, which had been stored for a long time: 8.43, 8.32, 8.34, and 8.54 per cent. available oxygen, giving a mean of 8.40 per cent., which compares favourably with the value of 8.45 per cent. as found by the iodimetric method. This method was found equally applicable to soap powders, and could be applied directly to such powders without any preliminary separation of soap or fatty acids or decomposition of the sodium carbonate usually present in such mixtures.

To test the method in this connection, a mixture was made up of 90 per cent. soap-powder and 10 per cent. of a sample of perborate having an available oxygen value of 8.45 per cent., both having been previously graded through a 40-mesh sieve. The following results were obtained: 0.86, 0.86, and 0.84 per cent. available oxygen, corresponding to 10.1, 10.1, and 10 per cent. sodium perborate.

As a further comparison with the iodide method, a mixture was made up containing approximately 13 per cent. sodium perborate at 8.45 per cent. available oxygen, 12 per cent. borax, 25 per cent. sodium carbonate, and 50 per cent. soap powder, from which the fatty acids were removed with ignited kieselguhr according to Litterschied and Guggiari's method (*Chem. Zeit.*, 1913, **37**, 677, 690). The perborate in the resulting filtrate was titrated by the iodide method, and gave a value of 1.24 per cent. available oxygen. The direct estimation by hypochlorite gave 1.13 per cent. available oxygen.

From this comparison the accuracy of the gas volumetric method with hypochlorite is satisfactorily confirmed. It should accordingly prove of value not only

on account of the advantages referred to, but also because it avoids the use of an acid solution, so that no inconvenience is caused in the estimation by the presence of carbonates in soap powder preparations.

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THE DIFFERENTIATION BETWEEN POOR AND ADULTERATED MILK.

By T. R. HODGSON, M.A., F.I.C.

LYTHGOE (*J. Ind. and Eng. Chem.*, 1914, 6, 899), as the result of the examination of 600 to 700 samples of milk in the laboratory of the Massachusetts State Board of Health, proposes to distinguish between poor and adulterated milk by calculation of the percentage of milk sugar present in the sample, from the percentage of fat and the percentage of total solids. Starting with Olson's formula (*J. Ind. and Eng. Chem.*, 1909, 1, 256) for the calculation of proteids from the total solids, $P = TS - TS/1.34$; and with Van Slyke's formula (*J. Amer. Chem. Soc.*, 1908, 30, 1166) for the calculation of the proteins from the fat, $P = 0.4(F - 3) + 2.8$, he has evolved the two following formulæ for the calculation of the milk sugar :

$$(a) S = TS - [F + 0.7 + (TS - TS/1.34)]$$

$$(b) S = TS - [F + 0.7 + \{0.4(F - 3)\} + 2.8]$$

and it is suggested that "the value of S obtained by both formulæ is nearly the same when the milk is pure, and varies from 4.5 to 5 per cent.; in skimmed or watered milks the values disagree, and are above 5 in the former and below 4 in the latter."

If this fact can be established, the Public Analyst will at last be in a position to rebut easily that familiar and ever-recurring defence, "the sample was sold exactly as it came from the cow." With a view to testing the statement, 100 samples, received for analysis under the Sale of Food and Drugs Acts and reported upon as genuine, were chosen at random from a large number of samples, and the values of S for both formulæ were calculated.

The greatest difference between S (a) and S (b) was 0.61.

The smallest difference between S (a) and S (b) was 0.01.

Percentage of samples showing a difference less than 0.1	...	...	39
"	"	between 0.1 and 0.15	25
"	"	" 0.16 and 0.20	21
"	"	" 0.21 and 0.25	6
"	"	" 0.26 and 0.30	5
"	"	" 0.31 and 0.35	3
"	"	" 0.36 and 0.40	Nil
"	"	" 0.41 and 0.45	Nil
"	"	over 0.45	1

Number of samples giving a value for S (a) under 4.0	...	...	Nil
" " " between 4.0 and 5.0	...	...	58
" " " over 5.0	...	...	42
" " " of S (b) under 4.0	...	...	Nil
" " " between 4.0 and 5.0	...	...	39
" " " over 5.0	...	...	61

The following six samples show a value for both S (a) and S (b) above 5.0, and, therefore, on the formulæ are skimmed :

Fat.	Solids-not-Fat.	S (a).	S (b).
4.2	9.55	5.36	5.57
4.1	9.40	5.27	5.46
4.0	9.29	5.22	5.39
3.9	9.26	5.22	5.40
3.8	9.23	5.22	5.41
3.7	10.84	6.45	7.06

It is obviously possible for a genuine milk to show a large difference, as it could not be argued, with any hope of success, that any of the above samples had been adulterated. On the basis that samples giving a value above 5.0 are skimmed, and below 4.0 are watered, at least 42 per cent. of the samples which complied with the Board of Agriculture standard had been deprived of a portion of their fat.

The values of S (a) and S (b) were then calculated on 100 samples, received for analysis and chosen at random, which did not comply with the Board of Agriculture standard and were reported upon as adulterated, with the following results :

The greatest difference between S (a) and S (b) was 0.54.

The smallest difference between S (a) and S (b) was 0.01.

Percentage of samples showing a difference less than 0.1	...	...	15
" " " between 0.1 and 0.15	...	...	13
" " " " 0.16 and 0.20	...	...	12
" " " " 0.21 and 0.25	...	...	11
" " " " 0.26 and 0.30	...	...	22
" " " " 0.31 and 0.35	...	...	12
" " " " 0.36 and 0.40	...	...	9
" " " " 0.41 and 0.45	...	...	5
" " " " over 0.45	...	...	1
Number of samples giving a value of S (a) under 4.0	...	...	5
" " " between 4.0 and 5.0	...	...	32
" " " over 5.0	...	...	63
" " " of S (b) under 4.0	...	...	11
" " " between 4.0 and 5.0	...	...	22
" " " over 5.0	...	...	67

The following six samples show a value for both S (a) and S (b) falling between and 4.0 5.0, and, therefore, according to the formulæ, are poor, but genuine samples

Fat.	Solids-not-Fat.	S (a).	S (b).
2·86	8·33	4·79	4·89
2·85	8·06	4·59	4·62
2·55	8·15	4·74	4·83
2·27	8·19	4·84	4·98
2·23	7·52	4·35	4·33
2·10	7·61	4·45	4·47

It is possible that there may be a little difficulty in persuading an English Public Analyst to realise that the above samples are "poor, but genuine." No less than 22 per cent. of the samples which failed to comply with the Board of Agriculture standard would, on these formulæ, have to be passed as genuine.

The values for S (a) and S (b) were then calculated on twenty samples of milk, which had admittedly been skimmed :

The greatest difference between S (a) and S (b) was 0·79.

The smallest difference between S (a) and S (b) was 0·03.

Percentage of samples showing a difference of less than 0·1	...	...	25
"	"	between 0·1 and 0·15	10
"	"	" 0·16 and 0·20	5
"	"	" 0·21 and 0·25	5
"	"	" 0·26 and 0·30	10
"	"	" 0·31 and 0·35	5
"	"	" 0·36 and 0·40	5
"	"	" 0·41 and 0·45	5
"	"	over 0·45	30
Percentage of samples giving a value for S (a) under 4·0	...	...	25
"	"	between 4·0 and 5·0	40
"	"	over 5·0	35
"	"	for S (b) under 4·0	30
"	"	between 4·0 and 5·0	25
"	"	over 5·0	45

The following five samples, although admittedly skimmed, show a value for both S (a) and S (b) between 4·0 and 5·0, and, therefore, according to the formulæ, are "poor, but genuine":

Fat.	Solids-not-Fat.	S (a).	S (b).
1·61	7·88	4·77	4·94
0·57	6·76	4·20	4·23
0·42	7·36	4·69	4·89
0·39	6·75	4·24	4·29
0·30	7·31	4·68	4·89

It would be ludicrous to describe any of the above samples as "poor, but genuine." No less than 25 per cent. of the samples of skimmed milk gave a value for both S (a) and S (b) falling between 4.0 and 5.0.

It is quite obvious that a sample which has been adulterated may give a value nearly the same for both S (a) and S (b), and also give a value falling between 4.0 and 5.0; the formulæ, therefore, show no advantage over the Board of Agriculture standard, especially if that standard is administered, as in due course it will be administered, under the provisions of The Milk and Dairies (Consolidation) Act, 1915.

Further, in this connection, attention may well be drawn to the now well-recognised formula, demonstrated by Richmond ("Dairy Chemistry," p. 152), that watered milk may easily be distinguished from abnormal milk by a consideration of the ratio of lactose, protein, ash. Richmond has shown that this ratio is extraordinarily exact, and that the average proportion is 13 : 9 : 2. He has determined the milk-sugar, protein, and ash on a large number of samples, and, by plotting the figures thus obtained against the average figures for solids-not-fat, has shown that well-defined breaks occur between 8.8 per cent. and 8.9 per cent. and between 8.4 per cent. and 8.5 per cent., thus demonstrating that a naturally abnormal milk may be distinguished from a watered milk by a marked departure from the ratio.

34, JOHN DALTON STREET,
MANCHESTER.



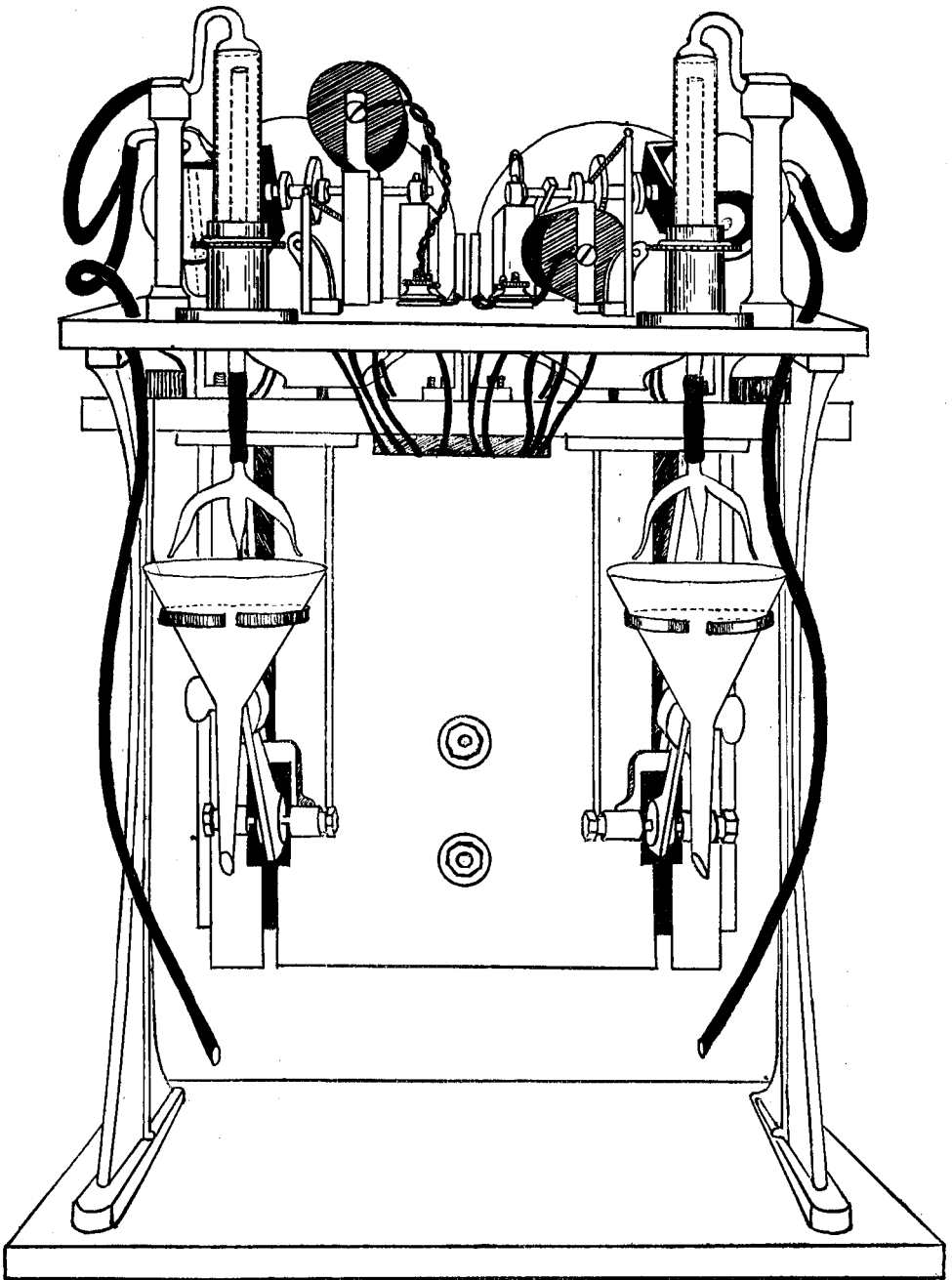
MACHINE FOR WASHING PRECIPITATES.

By ERIC SINKINSON, D.I.C., A.I.C.

THE need for automatic appliances is becoming more apparent every day in institutions where rising costs limit the scope of work, as in the chemical laboratory. The time of the analyst is largely taken up with filter-washing, decanting, and other tedious operations which must be carried out with great precision and care, yet might be applied to advantage in other directions if released from these somewhat mechanical duties.

The machine described below has been devised to wash precipitates in as expeditious a manner as possible, with hot or cold water, dilute acid or alkalis, as required, with probably the highest degree of precision possible.

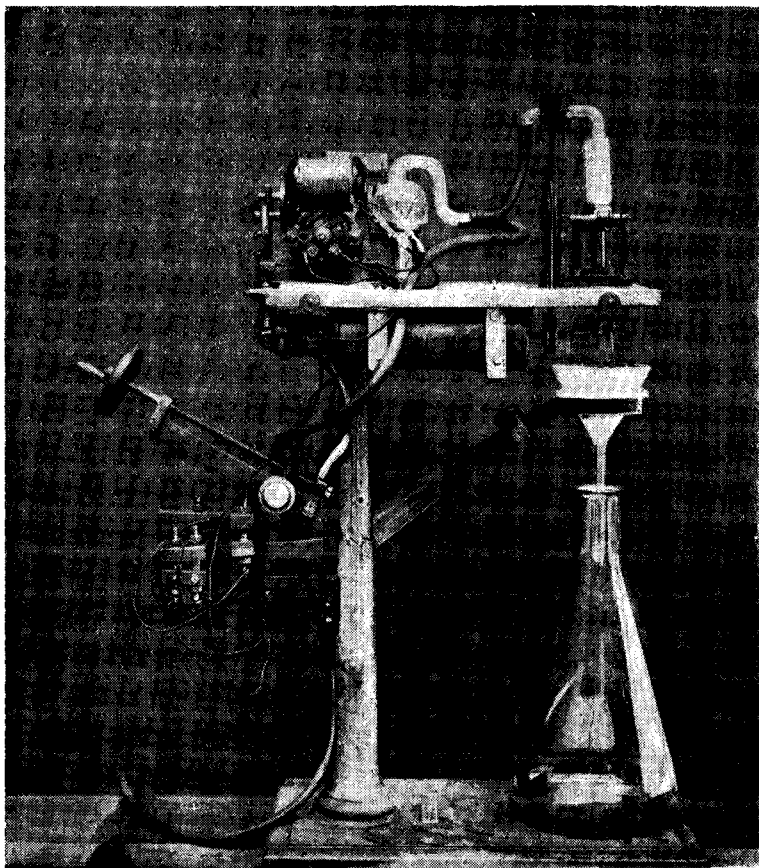
The principle employed in its construction is the rocking arm. At one end is a split ring bevelled so as to hold a filter funnel of the usual type employed in analytical laboratories; at the other is a counterpoise to adjust for different weights of funnel. Also a subsidiary arm carries a commutator to reverse a motor, according to the position of the arm, which has a free movement of a quarter of an inch between two stops. The motor drives a mercury valve by means of a worm gearing fitted to the countershaft. When the motor is run in one direction the valve closes, and on reversal opens. The valve is connected at one side to the distilled water supply, etc., and at the other to a jet which can be rotated either by a second motor, or, in



the modified form of machine, by the motor which controls the valve. The jet is connected to the valve through a sleeve partially filled with mercury, thus

permitting its rotation. The nozzle is arranged to direct the wash liquid round the edge of the filter paper in the funnel.

When working, the machine is connected up to an electric supply of suitable voltage, and the valve inlet to the water-supply, which latter may be contained in a tinned copper vessel, or glass flask, or even a thermos flask; in the two former cases it is heated by a burner, in the latter hot water may be introduced.



A precipitate contained by a filter paper in the funnel is washed by installing the funnel in the split ring at one end of the rocking arm; the counterpoise at the other end is adjusted to allow for the weight of the funnel and a suitable weight of water, which determines the operation of the machine. The current is turned on and water flows through the valve to the jet which rotates and thus completely sprays the filter paper. When a certain weight of water has flowed in, it presses down the rocking arm holding the funnel, and this reverses the current; this, by reversing the motor, causes the valve to return to the closed position, and the water stops flowing. At the same time the jet ceases to rotate. In this way

there is economy in current because none is being used during the period of outflow from the funnel into the beaker or flask placed to receive the filtrate. As soon as the funnel becomes "light" again the valve is reversed by the lifting of the funnel arm, and water flows through the rotating jet. So the operation of washing proceeds.

If the hot washing water be contained in a thermos flask, and a glass float introduced connecting a mercury cut-out placed in the main circuit of the machine, an adjustment can be made to stop the working of the machine after a pre-determined quantity of water has passed through the filter. For, as the water flows from the flask, the float descends and causes the iron rod connected to it to break contact from the mercury in the tube, through which current is supplied to the motors of the washer. The circuit is broken and the operation of the machine stopped. By this arrangement the washer can be left entirely to itself to carry out a filter-washing and automatically to check its action on completion.

The machine as described, with only one filter-washing unit, will not meet the requirements of an ordinary silicate analysis, in which the silica, lime, magnesia and sulphur may be washed rapidly, but the alumina may take a comparatively long time. Therefore a two-unit machine was constructed for this service. In order to cheapen the constructional work, it was found that one motor could be used instead of two by small modifications of the drive, to actuate both the valve and the rotating jet without in any way complicating the mechanism. As the electric motors are the most expensive parts of the apparatus, this modification made it possible to construct a double-unit machine on one base at a cost little above that for the single unit.

The diagram gives some idea of the appearance of the double-unit machine with the working parts exposed. These are covered in normally by aluminium covers, as are the contacts of the commutator, to render them dustproof. In addition, small improvements have been introduced, such as (i.) a triple jet for more effective and quicker working, and (ii.) double-walled valve and leading tubes, the annular spaces of which are exhausted to conserve the heat of the wash-water when the machine is washing slowly.

The advantages claimed for the apparatus are :

- (1) Time saving.
- (2) Great precision in washing.
- (3) Uniformity of washing.
- (4) Washing stopped automatically if the machine is left to itself.
- (5) Simplicity of construction ; all moving parts can be adjusted by the chemist himself.

In conclusion, the author thanks Miss W. Sinkinson of the University of Sheffield for the drawing of the double unit machine used to illustrate the text.

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NOTE.

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

THE ANALYST AND THE BEER PRICES AND DESCRIPTION ORDERS.

As a result of representations made by brewers, the Ministry of Food, after consultation with the Commissioners of Customs and Excise, issued in April, 1918, an instruction to all Local Food Committees. This instruction was to the effect that proceedings should not be instituted as regards the gravity of beers for which maximum prices are fixed, unless, after an allowance of 1 degree of original gravity either way, it could be proved that an offence had been committed (*Brewing Trade Review*, 1918, p. 95).

Although the analyst is concerned only with the original gravity as determined by him, yet in the course of professional practice it is well for him to be aware of this instruction (*loc. cit.*), as it is by no means uncommon for the Food Committee to rely solely on the figure returned by the analyst. It would be advisable for the analyst to point out to the Food Committee that this allowance should be made.

It may, perhaps, not be out of place to remind analysts that in cases of surcharges on worts made by Commissioners of Customs and Excise, 0.75 degree is deducted by the Principal Government Chemist from his original gravity determination before such surcharge is calculated (Finance Act, 1914, Section 7, Session 2).

EDITOR.

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ABSTRACTS OF PAPERS PUBLISHED IN OTHER JOURNALS.

FOOD AND DRUGS ANALYSIS.

Estimation of Arsenic in Organic Compounds. L. J. Rogers. (*Chem. Trade J.*, 1920, 66, 13.)—The sodium peroxide fusion of organic arsenic compounds was found to lead to a loss of arsenic, while the Johnson and Chittenden, as well as the Fresenius and Babo, methods also proved unsatisfactory. A rapid complete decomposition of organic arsenic compounds was finally achieved by employing ammonium persulphate in nitric acid solution, a method suggested by the decomposition of the dimethylglyoxime precipitate of nickel previous to cyanide titration. Half a grm. of the compound is transferred to a 500 c.c. Erlenmeyer flask, dissolved in 10 c.c. of water, and 5 c.c. nitric are then added. The whole is gently heated, and ammonium persulphate added in lumps until the solution is colourless, which usually occurs in fifteen to twenty minutes. The volume is made up to 100 c.c., and 5 c.c. of saturated microcosmic salt solution added; magnesia mixture is added in excess (about 40 c.c.), and if a precipitate forms, it is dissolved in dilute nitric acid. The whole is kept at nearly boiling-point, and excess of ammonia added in

the usual manner. The mixed precipitate of the phosphate and arsenate of ammonium and magnesium is cooled, allowed to stand about two hours, and then filtered and washed with dilute ammonia, followed by potassium iodide reduction and titration with thiosulphate. This co-precipitation was first employed by Berntrop, and effects a very perfect precipitation of the arsenic (*Zeitsch. fur anal. Chem.*, 1902, **41**, 11). The author believes the method to be superior to Lehmann's procedure, which has been adopted in some countries as the standard method for governmental inspection of salvarsan.

H. F. E. H.

Behaviour in Marsh's Apparatus of Certain Organic Arsenic Compounds used as Drugs. D. Ganassini. (*Boll. Chim. Farm.*, 1919, **58**, 385-390; through *J. Soc. Chem. Ind.*, 1920, **39**, 42A.)—The introduction of platinum chloride into the hydrogen flask of Marsh's apparatus retards or prevents the appearance of the arsenic deposit in the case of cacodylic acid. In the presence of a large excess of platinum chloride cacodylic oxide forms a yellow precipitate of cacodyl platin-chloride. If, however, only a small amount of platinum chloride is introduced, cacodylic oxide is evolved sooner or later. Even for the detection of mineral arsenic it is not advisable to use platinum chloride, since arsenic may be fixed as platinum arsenide, with a loss of as much as 50 per cent. of the arsenic present. The yellow ring, probably of erythrarsine, produced, together with the ordinary black deposit, by cacodylic acid in the Marsh test is a characteristic reaction. It may be obtained quantitatively by immersing the evolution flask of Marsh's apparatus in a bath of molten lead (about 335° C.). Atoxyl and salvarsan give the ordinary arsenic deposit in Marsh's test, but neosalvarsan and methylarsenic acid behave in an analogous manner to cacodylic acid, giving a yellow ring under the same conditions. In the case of cacodylic acid, however, the gas forms dense white fumes, and when conducted into Bettendorf's reagent (stannous chloride solution saturated with hydrogen chloride), it does not form a yellow precipitate. In the case of methylarsenic acid the formation of the yellow ring is not accompanied by the appearance of white fumes, and the gas gives an abundant precipitate with Bettendorf's reagent. The lemon-yellow ring given by neosalvarsan may be distinguished from the other two by the fact that it is only formed at a high temperature, does not change to black, and is rapidly dissolved by ammonia solution.

Application of Silicotungstic Acid to Estimation of Alkaloids. E. Taigner. (*Zeitsch. anal. Chem.*, 1919, **58**, 346-352.)—In estimating alkaloids in very small quantities of material, the author investigated the properties of the silicotungstic acid compounds of atropine, strychnine, and cocaine, said by Bertrand (*Bull. Soc. Chim.*, 1903, **21**, 434) to have the composition $12\text{WO}_3 \cdot \text{SiO}_2 \cdot 2\text{H}_2\text{O} \cdot 4$ alkaloid. This composition is confirmed for the substance dried to constant weight at temperatures not exceeding 40° C. Drying to constant weight at 40° C. is slow, but it is found that the whole of the water can be expelled at 100° C. the composition of the compounds being then $12\text{WO}_3 \cdot \text{SiO}_2 \cdot 4$ alkaloid. Drying to constant weight even at 100° C. is slow, but constant weight is quickly reached

at 120° C., whilst the compounds are not decomposed below 150° C. if nearly dry. When very moist they melt at about 100° C.

The alkaloid in presence of hydrochloric acid is precipitated by means of a 10 per cent. solution of silicotungstic acid, sodium chloride is added, and the precipitate is filtered off and washed with 1 per cent. hydrochloric acid, dried in a steam oven and then at 120° C., and weighed. G. C. J.

Moisture Content of Cereals. O. A. Nelson and G. A. Hulett. (*J. Ind. and Eng. Chem.*, 1920, 12, 40-45.)—The method used for the estimation of moisture in cereals and other colloidal organic substances consisted essentially in heating the material under a very low pressure for definite periods of time. The water liberated was condensed in a small tube surrounded by solid carbon dioxide. The pressure maintained in the apparatus was often less than 0.0001 mm.; a Töpler mercury pump was used for the purpose, and gases, other than water vapour, evolved as the result of decomposition, were collected, and their volume measured. In this way the smallest amount of decomposition could be measured, and it could be ascertained at what temperature and for what length of time a substance could be heated without yielding an appreciable amount of water due to decomposition. When measurable decomposition occurred, observations of the evolution of gases and water gave an indication of the rate of decomposition at the temperature employed. The moisture-temperature curves obtained for wheat flour, maize flour, maize starch, cellulose (filter-paper and cotton-wool), and edestin, did not show any distinct break before a temperature of 184° C. was reached, and the heating continued for three hours or longer. All moisture had not been evolved at the time decomposition commenced, and the flat parts of the curves were extrapolated to 250° C., at which temperature it was not possible for any absorbed water to be present. The results obtained for the cereal flours were about 1 per cent. higher than those found by heating at 100° C. *in vacuo*. W. P. S.

Purified Cresol (Cresylic Acid). H. C. Hamilton. (*J. Ind. and Eng. Chem.*, 1920, 12, 50-51.)—The following method is recommended for the purification of crude cresol. The substance is dissolved in water containing an equivalent quantity of sodium hydroxide, using sufficient water to form a 25 per cent. sodium cresylate solution; the solution is then boiled, or steam is passed through it until all odour of pyridine, etc., has been removed. Water should be added from time to time to replace that lost by evaporation. After cooling, floating oils may be skimmed off, whilst any remaining naphthalene is removed by filtration. The solution is then treated with a quantity of sulphuric acid equivalent to the sodium hydroxide used in the first place, the free cresol is separated carefully from the sodium sulphate solution (the cresol forms a supernatant layer over the latter), and distilled. Observation of the temperature at the end of the distillation permits the separation of higher boiling phenols from the cresol. W. P. S.

Estimation of Insoluble Solids in Jams, Preserves, and Marmalades. C. A. Clemens. (*J. Ind. and Eng. Chem.*, 1920, 12, 48-49.)—Twenty-five grms.

of the sample are mixed with 100 c.c. of water, boiled for five minutes, and the liquid filtered through an alundum crucible to which suction is applied. The insoluble residue is washed with hot water, then with alcohol and ether, dried at 100° C., and weighed. The alundum crucible has many advantages over the usual linen filter used for the purpose.

W. P. S.

New Hexabromide Method for Linseed Oil. L. L. Steele and F. M. Washburn. (*J. Ind. and Eng. Chem.*, 1920, 12, 52-59.)—Various published methods for the estimation of the hexabromide yield of linseed oil have been examined and found to give results which are not concordant. The following method has been developed with the object of removing this disadvantage. One gm. of linseed fatty acids is dissolved in a centrifuge tube in 10 c.c. of dry chloroform containing 3 per cent. (by volume) of absolute alcohol, the solution is cooled to -5° C., and bromine solution (bromine 1 volume, chloroform, as above, 2 volumes) is added slowly until an excess is present. The mixture is maintained for ten minutes at -5° C., the solvent then evaporated at 50° C. under a pressure of not more than 40 mm., and the residue heated at 55° to 60° C. below 40 mm. pressure for a further fifteen minutes. The tube and its contents are now cooled in ice-water, and the residue is washed three times with ether saturated with hexabromide at 0° C.; 20 c.c. of the cold ether are used each time and separated by centrifugal action. After drying at 60° to 70° C., the tube and its contents are weighed. Results are recorded showing that the hexabromide yield obtained in this way is a more constant value than is the iodine value of linseed oil. In the case of eight samples of genuine linseed oil, having iodine values varying from 181 to 185, the hexabromide yields ranged from 45.6 to 46.9 per cent. Cottonseed oil and tung oil gave no visible amounts of hexabromide, whilst soy bean oil yielded 2.2 per cent.

W. P. S.

Effect of Mould on the Oil in Maize. F. Rabak. (*J. Ind. and Eng. Chem.*, 1920, 12, 46-48.)—To ascertain the effect of mould growth on the oil contained in maize, a quantity of the latter was placed in a large stone jar and inoculated with *Penicillium*. Samples were taken at intervals during a period of ninety days, four samples being obtained in all, and these were examined. At the end of the ninety days the maize formed a dirty grey, mouldy, solid mass, having a strong, offensive odour. The results of the examination of the oils separated from the different portions are given in the following table, the first sample representing the maize before inoculation. The yield of oil is calculated on the dry substance.

	Yield Per Cent.	Acid Value.	Saponification Value.	Iodine Value.	Reichert-Meissl Value.	Soluble Acids (as Butyric), Per Cent.	Insoluble Acids, Per Cent.	Acetyl Value.	Unsaponifiable Matter, Per Cent.
1.	5.58	13.6	190.3	121.0	12.8	1.3	93.6	15.3	4.13
2.	4.33	46.7	191.7	121.3	2.95	1.5	90.5	10.6	9.9
3.	2.67	84.6	192.4	120.4	2.23	3.28	92.3	61.1	10.8
4.	2.06	68.7	185.1	119.0	2.92	2.35	91.7	28.4	15.3
5.	2.02	72.1	126.6	96.6	—	4.05	—	68.4	25.4

W. P. S.

Fat of Momordica Seeds. C. E. Corfield and E. Caird. (*Pharm. J.*, 1920, 104, 48-44)—*Momordica cochinchinensis* is a cucurbitaceous plant indigenous to Bengal, Formosa, and the Philippine Islands. When extracted with petroleum spirit the kernels (63.3 per cent. of the seed) yielded 47.06 per cent. of a pale brown viscid oil, which on exposure to the air was gradually converted into a white solid mass. Expression of the kernels at about 40° C. yielded a pale greenish-brown fat with the following characteristics: $[\eta]_{D, 40^{\circ} C.}$, 1.995; melting point, 28°-32° C.; acid value, 1.9; saponification value, 185.2; iodine value, 23.4; m. pt. of fatty acids, 46°-51° C.; and iodine value of fatty acids about 40. On exposure to the air the fat gradually became granular in texture owing to the effect of oxidation accelerated by the action of light. When heated to 50° C. the fat became less granular, more homogeneous and finally dark brown, and at 200°-240° C. was converted into a greenish-brown mobile liquid which remained fluid and of about the consistence of castor oil when cooled. In this form it behaved like a semi-drying oil, forming a transparent film on exposure for more than two days. The original fat consisted mainly of glycerides and contained no wax alcohols. C. A. M.

Squalene: A Highly Unsaturated Hydrocarbon in Shark Liver Oil. M. Tsujimoto. (*J. Ind. and Eng. Chem.*, 1920, 12, 63-72.)—In a previous paper (ANALYST, 1918, 43, 143) the author has shown that shark liver oil contains a high proportion of squalene, and he now gives the results of the examination of the liver oils obtained from thirty-six species of sharks. It is shown that oils of low sp. gr. (below 0.9 at 15°/4° C.) contained large quantities of squalene (up to 84.8 per cent.), whilst oils of high sp. gr. (above 0.9) did not, with a few exceptions, contain the hydrocarbon. The latter occurs more frequently in the liver oils from sharks belonging to the family *Squalidae*, but it is also present in notable quantity in the liver oils of *Scylliorhinidae*, *Chlamydoselachidae* (frill-shark), *Dalatiidae*, and *Cetorhinidae* (basking-shark). Squalene has a sp. gr. of 0.8591 at 15°/4° C.; at ordinary temperature it absorbs 20.3 per cent. of oxygen from the atmosphere in four days and 24 per cent. in twenty-eight days. It readily absorbs hydrogen chloride, yielding a hexahydrochloride, m.p. 125° C. (with decomposition), which is soluble in hot alcohol, hot acetone, warm carbon tetrachloride, and cold chloroform, but almost insoluble in ether, cold alcohol, and cold acetone; it also yields a hexahydrobromide, m.p. 125° C., and a hexahydroiodide, m.p. 108° C. To estimate the amount of squalene present in the oil, 50 grms. of the sample are distilled under 10 mm. (or less) pressure; the acidity of the distillate is estimated and calculated as oleic acid, and the quantity deducted from the weight of the distillate; the difference gives the approximate amount of squalene. Considering that squalene hexahydrochloride, $C_{30}H_{50} \cdot 6HCl$, has properties very similar to those of spinacene hexahydrochloride, $C_{29}H_{48} \cdot 6HCl$ (*cf.* Chapman, ANALYST, 1917, 42, 161), and that spinacene has been obtained from an oil of the *Squalidae* sharks, it is highly probable that the two substances are identical. W. P. S.

Occurrence of Squalene in the Oil from Shark's Eggs. M. Tsujimoto. (*J. Ind. and Eng. Chem.*, 1920, 12, 73.)—A female specimen of the shark named

Kinbei-zame (*Lepidorhinus kinbei*) contained twelve eggs; nine of these eggs, having a total weight of 1,260 grms., yielded 218 grms. of light-brown solid fat, which contained 33 per cent. of unsaponifiable matter, including about 13 per cent. of squalene.
W. P. S.

BACTERIOLOGICAL, PHYSIOLOGICAL, ETC.

Seasonal Variation in the Chemical Composition of Marine Algæ. L. Lapicque. (*Compt. rend.*, 1919, **169**, 1426-1428.)—Studies on the *Laminaria flexicaulis* showed that whereas the appearance and consistence of the fresh seaweed were practically the same at all seasons, the dry substance varied according to the season, being 24 to 25 per cent. in the summer and only 15 to 16 per cent. in March. When dried in the air the leaves become covered with a white efflorescence, which is purely saline in the case of the spring plants, but consists of saccharine substances in the summer leaves. This efflorescence is nearly pure mannitol, but a soluble carbohydrate remains in the interior of the leaves which somewhat resembles glycogen. This is extracted by digestion with 1 per cent. acetic acid at the temperature of the water-bath. It corresponds with the laminarin of Schmiedeberg, and is abundant in the summer leaves, but present merely as a trace in the spring. The composition of the dry substance of the plant at various seasons is shown in the table below:

Season.	Soluble Carbohydrates. Per Cent.	Ash Soluble. Per Cent.	Ash Insoluble. Per Cent.
Spring equinox	1.1	28.2	7.5
End of May	5.0	20.1	6.3
Summer solstice	8.9	15.8	6.4
August-September	33.9	13.4	4.6

Thus, after the spring, the cell juice of the seaweeds becomes richer in laminarin and mannitol and poorer in salts, this variation being probably the result of the chlorophyllian function under the influence of increased illumination. J. F. B.

Detection and Estimation of Albumen in Urine. O. Mayer. (*Zeitsch. anal. Chem.*, 1919, **58**, 337-346.)—For the detection of albumen, the author says, reliance should not be placed on any single test; two at least should be applied, and he gives preference to the following in the order named:

1. The urine is boiled with half its volume of a saturated solution of sodium chloride and acidified with acetic acid. A positive reaction is given if as much as 0.005 per cent. albumen is present. The salt tends to prevent, but does not always wholly prevent, the precipitation of mucinoid substances. A precipitate may consist wholly or partially of resin acids, but these are dissolved by adding two volumes of alcohol, which leaves albumen undissolved.

2. The possible ambiguity of the results of the above test is removed if a portion

of the urine mixed with an equal volume of 6 per cent. acetic acid develops no cloudiness. In that case mucinoid substances are absent.

3. For this test and for the quantitative test described below the following reagent, which is substantially that of Stütz, except that the proportion of sodium chloride has been increased, is used. It contains 10 grms. mercuric chloride, 25 grms. citric acid, and 56 grms. sodium chloride in 500 c.c. The urine (5 c.c.) is mixed with an equal volume of the reagent, when the presence of 0.001 per cent. albumen occasions a precipitate; but here, again, mucinoid substances may introduce ambiguity.

4. The urine is acidified with acetic acid, and mixed with five drops of a 20 per cent. solution of sulphosalicylic acid. As little as 0.0015 per cent. albumen gives an opalescence; larger proportions a definite precipitate. Mucinoid substances do not interfere, but urine, very rich in urates, may need diluting with an equal volume of water.

Estimation.—The method depends on reaction 3 above, carried out as a zone reaction, with urine more and more diluted until the limit of sensibility is reached. To 5 c.c. of the reagent in a test-tube, 5 c.c. of the urine (or a suitable dilution of the urine if preliminary tests indicate much albumen) are added. If a strong reaction is obtained, a weaker dilution is tested in a similar manner. If the result is again positive, a still weaker dilution is tested; but if no cloudy zone appear, an intermediate dilution is tried. A table is given, showing the approximate percentage of albumen necessary to give a visible reaction within a minute when the tubes are viewed against a black ground. The method is only an approximate one, but is quickly carried out, three or four experiments sufficing, with a little experience, to obtain results of sufficient accuracy for clinical purposes. The following is an abbreviation of the table given:

Dilution.	Percentage of Albumen.
Undiluted.	0.001
1 : 1	0.002
1 : 10	0.01
1 : 100	0.1
1 : 1000	1.0

G. C. J.

Mutual Precipitation of the Toxins and their Antitoxins. Titration of Antidiphtheritic and Antitetanic Sera. M. Nicolle, E. Debains, and E. Césari. (*Compt. rend.*, 1919, 169, 1433-1434.)—Advantage is taken of the mutual precipitating property of toxins and antitoxins to afford a method for the valuation of antidiphtheritic and antitetanic sera. The success of the method depends on the employment of concentrated toxins. Filtrates from the respective cultures are saturated with anhydrous sodium sulphate. The precipitate obtained is dried *in vacuo* over sulphuric acid, ground to a homogeneous powder, and 0.8 gm. of the powder is dissolved in 10 c.c. of distilled water. Equal parts of the toxic solution and a 10 per cent. neutral solution of gelatin in physiological water are mixed

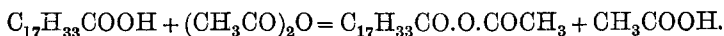
together, and 1 c.c. of the mixture is placed in each of a series of tubes. The solution is then allowed to set in the ice-box. One c.c. of antitoxic serum at increasing dilutions is poured upon the solid jellies, and these are set aside for two hours at the ordinary temperature and then examined. A positive result is indicated by a whitish disc at the junction between the diluted serum and the toxin-gelatin. It is important that both solutions should be absolutely clear. The antidiphtheritic serum is delivered at a standard of 300 units per c.c. and the antitetanic at 4,000 units. Both these standards correspond, on the above test, with the appearance of a sharp disc at a dilution of 1 : 50. The results of the method performed *in vitro* as above correspond perfectly with those obtained in standardisation on the living animal.

J. F. B.

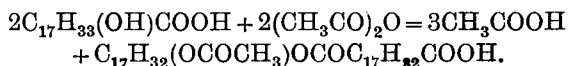
ORGANIC ANALYSIS.

Errors in the Determination of the Acetyl Value and their Remedy.

A. Grün. (*Oel u. Fettind.*, 1919, 1, 339-341, 364-367; *Chem. Zentr.*, 1919, 90, IV., 645-646; through *J. Soc. Chem. Ind.*, 1920, 39, 33A.)—The tendency of hydroxy-acids to form inner anhydrides is a source of error which is not entirely eliminated in Lewkowitsch's method of determining the acetyl value, since mixed anhydrides may be formed as in the reaction :



When such anhydrides are formed, too much acetic acid will be found by the distillation method. A more serious source of error is that caused by the formation of inner esters of hydroxy fatty acids. For example, ricinoleic acid, after eight hours' boiling with acetic anhydride, was converted, not into acetylricinoleic acid, but into acetyldiricinoleic acid :



In the case of this by-reaction the acetyl values determined by Lewkowitsch's method will be too low, whilst by Benedikt and Ulzer's method they will be too high. An objection to the ordinary methods of determining the acetyl values of neutral fats is that reciprocal esterification between the triglyceride and acetic anhydride may take place, whilst it is difficult to distinguish between the different form of hydroxylated constituents indicated by the value. To obviate these difficulties a method has been devised in which the fatty acid esters are acetylated. These esters are prepared by heating the fat with methyl or ethyl alcohol and 1 to 2 per cent. of hydrochloric or sulphuric acid, evaporating the alcohol, and neutralising, washing, and drying the residue. Neither acid anhydrides nor inner esters can be formed on acetylating these esters, which is preferably done by the original method of Benedikt and Ulzer, after removal of volatile esters. The acetyl value of free acids is obtained by multiplying the acetyl value of the esters with the theoretical acetyl value of the free acids and dividing by the theoretical acetyl value of the esters. In the case of the methyl esters, calculation into the triglyceride is unnecessary, since the difference between the group C_3H_9 and the

group C_3H_5 is negligible. For the determination of the amount of mono- and di-glycerides, the neutralised fat is acetylated and the acetic acid content of the product estimated. The difference between the acetyl value of the neutral fat and that of the mixture of methyl esters prepared from it corresponds to the amount of mono- and di-glycerides. Acetylation of the fatty acid esters instead of the free acids or neutral fat is also advisable for the determination of the hydroxyl value.

Estimation of Aniline in Commercial Anilines. W. J. Sanderson and W. J. Jones. (*J. Soc. Chem. Ind.*, 1920, 39, 8T.)—A method based on the relation between the freezing-point of the sample and its aniline content is described. Owing to the solubility of water in aniline, it is necessary first to bring the sample to a definite state of dehydration or hydration. Definite hydration is effected by adding to the sample of aniline about 3 per cent. of water, which is just sufficient to saturate it, and then about 20 per cent. of solid sodium hydroxide. The mixture is allowed to stand for twelve hours or longer, with occasional shaking, after which the aniline layer is separated and its freezing-point determined by the usual Beckmann method. The commercial aniline thus treated comes to an equilibrium with the water, and the freezing-point then depends only on the aniline content of the sample. For example, pure aniline treated in the above manner holds in solution an amount of water which causes it to freeze at $-6.30^\circ C.$, whereas pure dry aniline freezes at $-6.00^\circ C.$ The thermometer used should be graduated in fifths or tenths of a degree, and verified at 0° and at $-6.00^\circ C.$ by means of aniline purified by repeated freezing, followed by dehydration over sodium hydroxide, and finally by distillation. In determining the freezing-point, the temperature falls at first and then suddenly rises; the highest temperature then recorded is taken as the freezing-point, t , of the sample. If there be x parts by weight of aniline per 100 parts of organic matter in the sample, and if the chief impurity is nitrobenzene, as in aniline oils for blue, then $x = 113.3 + 2.11 t$. If the chief impurities are the toluidines, as in aniline oils for red, $x = 110.7 + 1.70 t$.

J. F. B.

Fuel Value of Volatile Liquid Mixtures. G. Barsky. (*J. Ind. and Eng. Chem.*, 1920, 12, 77.)—The use of gelatin capsules for containing the sample is recommended in the estimation of the fuel value of volatile liquids by the bomb calorimeter. The capsules are made by turning in the caps of ordinary capsules, so that the concave end thus formed fitted the meniscus when the capsules are filled. The igniting wire is wound several times round the capsule.

W. P. S.

Motor Gasoline [Petrol] Properties, Laboratory Methods of Testing and Practical Specifications. E. W. Dean. (U.S. Bureau of Mines, *Technical Paper*, 1919, 214, pp. 36.)—The author states that it is now definitely established that the most untrustworthy test in vogue for gasoline is that of the average user who "tries it out" in his car. Engine tests, if conducted in the laboratory, in connection with power measurements, are still the last word in determining the utility of motor fuel, but the internal combustion motor is so complex a mechanism that it cannot be made to serve as an analytical instrument, except when handled by experts.

Properly interpreted results of an analysis in the chemical laboratory give more trustworthy information concerning the utility of a grade of gasoline than anything less than the most elaborately conducted engine-dynamometer tests or the collective experience of a large number of users.

A specification should require gasoline to be water white when viewed in a 4-oz. sample bottle, free from acid, and to comply with a distillation test, the details of which must vary with the purpose for which the gasoline is required. In some cases it may be necessary to introduce into the specification the "doctor" test, a corrosion or gumming test, a test for degree of unsaturation and a limit of vapour pressure, the last being necessary to insure safety in shipment by tank wagons, the limit suggested being 10 lb. per sq. inch.

Gasoline is rarely other than water white and rarely acid. It should, however, always be tested for acid, free or combined, and the test should be made not on the original sample, but on the residue left in the Engler flask after distillation. Carelessly refined gasoline may contain acid compounds which decompose during distillation.

The conditions under which the distillation is to be conducted must be rigidly defined. The Bureau of Mines apparatus is described and illustrated, and might be cited in an American specification. It is substantially that recommended by the American Society for Testing Materials for the analysis of turpentine substitutes, except that the thermometer used is of different range. The flask is a 100 c.c. Engler flask, and the rate of distillation 4-5 c.c. per minute. For ordinary automobile gasoline the author recommends that the temperature when 20 per cent. has distilled shall not be below 70° F., nor above whatever limit is fixed after due consideration of conditions of use; that the temperature when 90 per cent. has distilled shall not be above another limit similarly chosen; that the temperature when 50 per cent. has distilled shall not be higher than a mark halfway between the upper 20 per cent. limit and the 90 per cent. limit; and that the dry point shall not exceed the 90 per cent. limit by more than 40° C. He deprecates the introduction into the specification of an "initial" boiling temperature, as this is so difficult to determine that disagreement is likely to arise between buyer and seller, whilst the 20 per cent. (or if preferred a 10 per cent. or 5 per cent.) reading gives information of the same kind without risk of disagreement. The dry point is less often the cause of serious disagreement than "initial" readings, but too much stress should not be laid on a dry point test when the 90 per cent. test complies with the specification.

What figures should be introduced into the specification the author leaves to users, with the warning to make their specification as easy as possible with due regard to their requirements. If they make their specification more exacting than is necessary, they will perforce pay more and will be doing public disservice by making unnecessary inroads into the world's supply of gasoline. To be satisfactory, gasoline must possess sufficient volatile constituents to permit ready starting of a cold motor and the range of volatility must not exceed the limits of the vapourising power of the engine. Short of that, however, the larger the percentage of the original crude oil which can be utilised as motor-spirit, the greater the world's supply, and the less the cost per gallon.

The "Doctor" Test.—This test, although largely employed in refineries for detecting certain types of decomposable sulphur compounds, does not appear to have been published in any journal easy of access; the author acknowledges the assistance of C. J. Robinson of the Standard Oil Company in formulating the description he gives of it. About 125 grms. sodium hydroxide are dissolved in 1,000 c.c. water, 65 grms. litharge are added, the mixture shaken for fifteen minutes, allowed to stand for a day and the clear liquid (doctor solution) siphoned off. In making the test 10 c.c. gasoline and 5 c.c. doctor solution are shaken vigorously in a test-tube for fifteen seconds, a pinch of flowers of sulphur is added, shaking repeated for fifteen seconds and the mixture then allowed to settle. The quantity of sulphur used should be such that practically all of it floats on the surface separating the gasoline from the aqueous layer. If the gasoline is discoloured, or if the sulphur film is so dark that its yellow colour is noticeably masked, the test is reported positive and the gasoline condemned as "sour." If the liquid remains unchanged in colour, and if the sulphur film is bright yellow or only slightly discoloured with grey or flecked with black, the test is reported negative and the gasoline considered "sweet."

G. C. J.

Estimation of *p*-Phenylenediamine. T. Callan and J. A. R. Henderson. (*J. Soc. Chem. Ind.*, 1919, 38, 408-410r.)—A stock solution of sodium hypochlorite is prepared by diluting to a litre about 50 c.c. of commercial sodium hypochlorite containing 12 to 15 per cent. of available chlorine. This stock solution is accurately titrated against $\frac{N}{10}$ sodium arsenite, using starch-iodide paper as indicator. Exactly 100 c.c. of the hypochlorite solution are diluted with about 100 c.c. of water, about 1 gm. of sodium carbonate is added, and 10 c.c. of the solution to be analysed, containing 2 to 6 per cent. of *p*-phenylenediamine dissolved in a slight excess of hydrochloric acid, are added slowly with stirring. The mixture should give a strong reaction with starch-iodide paper, otherwise the experiment must be repeated with less *p*-phenylenediamine or more hypochlorite. On the addition of the *p*-phenylenediamine, benzoquinone dichloroimide is rapidly precipitated as an almost white substance. The turbid solution is then titrated, without filtration, with $\frac{N}{10}$ arsenite, using starch-iodide paper as outside indicator, the end point being very sharply indicated by the disappearance of the blue colour on spotting out. The difference between the volume of arsenite required by the hypochlorite itself, and by the hypochlorite plus diamine, is the measure of the latter, each c.c. corresponding to 0.0018 gm. *p*-phenylenediamine.

G. C. J.

Estimation of Sulphates in the Presence of Organic Sulphonic Acids. T. Callan, J. A. R. Henderson, and R. Barton. (*J. Soc. Chem. Ind.*, 1919, 38, 410-411r.)—Experiments are described which show that barium sulphate is not appreciably soluble in dilute solutions of organic sulphonic acids, and that there is little danger of barium sulphate being contaminated with co-precipitated barium sulphonates when precipitated from solutions containing organic sulphonic acids under the conditions generally employed in analytical work. Naphthalene- β -mono-sulphonic acid behaves exceptionally, however, and in its presence sulphates should be precipitated in cold, faintly acid, and highly dilute solution.

The following volumetric method is rapid and accurate. A quantity of the substance containing the equivalent of about 0.1-0.2 gm. anhydrous sodium sulphate is dissolved in water, and, if acid, is rendered faintly alkaline with ammonia containing calcium chloride to precipitate any carbonate which is filtered off. The solution is boiled until it no longer smells of ammonia. Exactly 20 c.c. of $\frac{N}{4}$ barium chloride are added, and the heating continued for a few minutes. The excess of barium chloride is then titrated with $\frac{N}{4}$ potassium chromate, using starch-iodide paper as indicator, the end point being determined by allowing a drop of the solution to fall on the test-paper so that the barium chromate remains concentrated in one spot whilst the clear solution spreads around it. A drop of very dilute hydrochloric acid is then spotted on to the paper so that the acid runs into the clear rim of the first spot. A blue colour develops within about ten seconds when excess of soluble chromate is present. An immediate production of colour indicates considerable excess of chromate.

G. C. J.

Estimation of Thiophene in Commercial Benzenes. A. Meyer. (*Compt. rend.*, 1919, 169, 1402-1404.)—In the manufacture of chlorobenzene by the catalytic action of iron turnings, the presence of thiophene has an extremely injurious influence on the activity of the catalyst, which becomes covered with a black deposit, consisting of a compound of thiophene with ferric chloride. The method described for the estimation of thiophene is a modification of that of Denigès, which is based on the precipitation of the thiophene by mercuric sulphate in the presence of methyl alcohol, the compound formed having the formula $\text{SO}_4(\text{HgO})_2\text{HgSC}_4\text{H}_4$. The reagent consists of a solution of 50 grms. of mercuric oxide in a mixture of 200 c.c. of sulphuric acid and 100 c.c. of water. The methyl alcohol always contains traces of acetone, which forms a precipitate with the mercuric salt, so that a blank determination must be made. In carrying out the test, 75 c.c. of methyl alcohol, 20 c.c. of Denigès' reagent, and 5 c.c. of benzene are placed in a stoppered bottle, and a similar mixture is made for the blank experiment, using benzene free from thiophene. The mixture is shaken occasionally during half an hour and filtered. Ten c.c. of the filtrate or of the clear supernatant liquid, if filtration be omitted, are withdrawn, diluted with 20 c.c. of water, a few drops of nitric acid free from nitrous acid are added and about 1 c.c. of iron alum solution. The mixture is then titrated with $\frac{N}{10}$ thiocyanate solution to a permanent pink. The difference between the blank titration and the main titration gives the thiocyanate equivalent of the mercury precipitated by the thiophene. One c.c. of $\frac{N}{10}$ thiocyanate corresponds to 0.01 gm. Hg, and this, multiplied by 0.14, gives the thiophene in the precipitate.

J. F. B.

INORGANIC ANALYSIS.

Estimation of Metallic Aluminium in Aluminium Dross. F. K. Bezenberger. (*J. Ind. and Eng. Chem.*, 1920, 12, 78-79.)—The dross contains a high percentage of alumina, besides metals such as copper, zinc, and iron; to estimate metallic aluminium in this mixture, advantage is taken of the fact that the metal is dissolved by bromine-water, whilst the oxide is scarcely attacked. About 1 gm. of

the dross is treated with saturated bromine-water, and a few drops of bromine are added from time to time as long as the reaction continues. The solution is then heated to expel free bromine, filtered, the insoluble portion washed, and the aluminium in the filtrate precipitated as hydroxide by ammonia. The precipitate is collected, washed, and ignited; it contains iron and copper oxides, and the quantity of these is estimated by treating the ignited precipitate with 10 per cent. sulphuric acid, which dissolves the iron and copper oxides and also a small quantity of the alumina. The copper is then deposited electrolytically, and the iron, after reduction, is titrated with permanganate solution. The sum of the iron and copper oxides thus found is deducted from the weight of the ignited precipitate in order to obtain the amount of alumina present as aluminium in the sample.

W. P. S.

Estimation of Arsenic in Tin and Tin-Plate. L. Vallery. (*Comptes rend.*, 1919, **169**, 1400-1402.)—The Marsh method gives totally erroneous results when applied to the estimation of arsenic in tin, since the formation of arsenuretted hydrogen is incomplete. The method now described is based on the distillation of the arsenic in the form of arsenious chloride in the manner usually employed in metallurgical analysis, and the estimation of the arsenic in the distillate colorimetrically after reduction to colloidal arsenic by means of hypophosphorous acid. The colorimetric method possesses advantages over volumetric methods—*e.g.*, by iodine or potassium bromate—in that the reduction by hypophosphorous acid is specific for arsenic under the conditions of the experiment, and the arsenic is produced in a visible form. The solution to be tested is compared with a standard solution in an accurate colorimeter, and the errors of the method may be minimised by matching another portion of the standard solution with the original in the same compartment of the instrument as the unknown solution. The same method may also be combined with the Marsh method for other materials by absorbing the arsenuretted hydrogen in concentrated nitric acid, then evaporating in the presence of sulphuric acid until white fumes are formed, taking up the residue with water and reducing with hypophosphorous acid. The author regards the French Government specification of 1 part of arsenic per million as too exacting in the case of refined tin, since he has generally found results ranging from 2 to 5 parts per million, and he suggests that the stringency of this specification may be due to the erroneous results obtained by the Marsh method.

J. F. B.

Estimation of Combustible Matter in Silicate and Carbonate Rocks. A. C. Fieldner, W. A. Selvig, and G. B. Taylor. (U.S. Bureau of Mines, *Technical Paper*, 1919, **212**, pp. 24.)—From 0.2 to 1 grm. of the finely ground sample is weighed with a 100 c.c. platinum dish. If the silicate rock be free from more than traces of carbonate, 15 c.c. of concentrated hydrochloric acid are added and the mixture heated on the hot plate for ten minutes. Then 20 c.c. of hydrofluoric acid are added and the contents of the dish are heated to incipient boiling until the organic matter seems to be decomposed. By conducting the digestion at temperatures not above that of incipient boiling, losses of organic carbon and hydrogen at this stage are reduced to negligible

proportions. About an hour is required for the digestion. More of the acid mixture is added from time to time to maintain the volume above 15 c.c. If concentrated much more than this there is some risk, amounting to a certainty if evaporation be pushed to dryness, that insoluble hydrated acid fluorides will form. When decomposition is complete, the mixture is evaporated to 15 c.c., 25 c.c. hydrochloric acid are added and the mixture boiled, and in order to redissolve acid aluminium fluoride an equal volume of hot water is added and the mixture again boiled and filtered hot through a small asbestos filter. This is washed free from chlorides with hot water, dried at 105° C., transferred to a combustion tube, and carbon and hydrogen are determined in the usual manner. If the sample is chiefly organic matter, the preliminary digestion is best conducted on a water-bath.

Carbonate rocks are first treated with 30 c.c. dilute (1 : 2) hydrochloric acid, the insoluble residue is filtered off on asbestos, washed with acid water, transferred to a platinum dish and then digested with hydrochloric and hydrofluoric acids and otherwise treated as described above for silicate rocks. The preliminary treatment with hydrochloric acid is necessary to avoid the subsequent formation of comparatively insoluble hydrated compounds of the type $\text{CaF}_2 \cdot 2\text{HF} \cdot 6\text{H}_2\text{O}$.

G. C. J.

Qualitative and Quantitative Test for Molybdenum in Steel and Iron.

S. L. Malowan. (*Zeitsch. anorg. Chem.*, 1919, 108, 73-80; through *J. Soc. Chem. Ind.*, 1920, 39, 27A.)—A specific and very sensitive test for molybdenum is given by xanthic acid. The test is best carried out with freshly prepared xanthate solution in the following manner: A solution of potassium hydroxide in absolute alcohol is shaken with excess of carbon bisulphide until no more of the latter is dissolved. To the solution so obtained 30 per cent. acetic acid is added until a slight yellow turbidity is formed, and the reagent is added drop by drop to the solution to be tested. If the latter has been prepared by dissolving the test material in strong acid, most of this should be neutralised before adding the reagent. If molybdenum is present, an intense red colour immediately develops, which is quite stable in water, and the intensity of which is proportional to the amount of molybdenum present. The sensitiveness of the reaction is such that 0.000005 gm. Mo in 0.0007 per cent. solution can be detected with certainty in presence of other elements. The colour is readily soluble in alcohol, amyl alcohol, ether, and chloroform, less readily in petroleum spirit and benzene. It is readily extracted from its reddish-violet ethereal solution by alkalis, and is precipitated from the alkaline solution by acids. The ethereal solution decomposes on standing, with formation of molybdenum sulphide. The reaction is not given by vanadium, tungsten, titanium, or uranium; chromates give a dark coloration with xanthic acid, and should be reduced, if present, before the test is made. The reaction can be used for the colorimetric estimation of molybdenum, by comparison with a standard solution; but, since ethereal solutions decompose too quickly, the ether should be mixed with 35 per cent. of petroleum spirit for the extraction and with 70 per cent. of petroleum spirit for the necessary dilution.

Indirect Detection of Tin. F. Feigl. (*Chem. Zeit.*, 1919, 43, 861.)—The author briefly summarises the difficulties attendant on the detection of traces of tin in presence of antimony by the more usual methods, and recommends the following indirect method. The mixed sulphides are dissolved in hot, strong, hydrochloric acid, the antimony and tin are precipitated by means of pure zinc and then treated with strong hydrochloric acid, which dissolves the whole of the tin (which dilute acid will not do), and, if some antimony is also dissolved, it will not interfere. The solution is added to hot dilute ferric chloride solution, solid Rochelle salt or citric acid is added to prevent the subsequent precipitation of ferric hydroxide, and then an ammoniacal alcoholic solution of dimethylglyoxime is added. A red coloration proves the presence of ferrous iron and, indirectly, of tin in the original solution. As little as 0.00001 mgrm. tin may be detected in 1 c.c. G. C. J.

New Reaction of Salts of Tin. A. Mazuir (*Ann. Chim. anal. appl.*, 1920, 2, 9)—A reaction for tin is based upon the fact that stannous and stannic iodides are completely insoluble in concentrated sulphuric acid: From 1 to 2 c.c. of the solution under examination is treated with an equal volume of a 10 per cent. solution of potassium iodide, and then shaken with 1 to 2 c.c. of concentrated sulphuric acid. In the presence of tin a characteristic yellow precipitate is immediately produced. The test is capable of detecting tin in a solution containing 0.1 to 0.2 gm. per litre. Arsenic gives a similar reaction, but the resulting arsenic iodide is completely insoluble in concentrated hydrochloric acid, whereas the iodides of tin dissolve readily in that acid in the cold. Antimony under the same conditions gives a flocculent brick-red precipitate. The metals of the antimony group do not interfere with the test. C. A. M.

APPARATUS, ETC.

Constant Temperature Still-head for Light Oil Fractionation. F. M. Washburn. (*J. Ind. and Eng. Chem.*, 1920, 12, 73-77.)—The fractionating apparatus described consists of two parts—a Hempel column attached to the distillation flask and a constant temperature still-head. The latter is a spiral, about 6 inches in diameter, made from a 12-foot length of $\frac{3}{4}$ inch wrought-iron pipe. The spiral is immersed in an oil-bath, and its lower end is connected with the side-tube at the top of the Hempel column, whilst its upper end is provided with a side-tube which connects with an ordinary condenser. The oil-bath is heated to the required temperature by means of a coil of resistance wire immersed in the bath, and maintained at that temperature by a mercury thermoregulator. The distillation flask has a capacity of 1,500 c.c., so that 1,000 c.c. of oil may be taken for the distillation, and the flask is heated by a Rose burner with a hemispherical top covered with asbestos-coated gauze. Almost all the components of a mixture such as benzene, toluene, and solvent naphtha is obtained in a practically pure state; the intermediate fractions have each only about 1.5 per cent. of the volume of the total oil, and the compositions of these intermediate fractions are found by separate

distillations in a standard apparatus, reference being made to previously constructed curves to ascertain the percentage of benzene and toluene and of toluene and xylene present.

W. P. S.

ERRATUM.—ANALYST, *December*, 1919, p. 416, line 21 from top, for G. Hughes read J. Hughes.



GOVERNMENT REPORT.

Report of the Government Chemist upon the Work of the Government Laboratory for the Year ended March 31, 1919. Md. 419. (Price 2d. net. H.M. Stationery Office.)—The total number of samples examined in the course of the year, including those dealt with at the outport chemical stations, was 289,180 as compared with 269,118 in the preceding year. The number examined at the central laboratory alone amounted to 184,418, the remaining 104,762 samples having been examined at various chemical stations. Partial revival of trade and the removal of restrictions on wine imports led to an increase of 42,123 samples of wine examined, mainly at the ports of entry.

CUSTOMS AND EXCISE: BEER.—The total number of samples of finished beer examined for the year in connection with duty, was 18,802. The object of the examination is to determine the original gravity of the beer before fermentation, as it is on this basis that the duty charge is raised. *Materials Used in Brewing.*—The number of samples examined was 205, of which 132 were malt, corn, brewing sugars, and exhausted grains, and 73 yeast foods and miscellaneous substances used, or proposed to be used, in the preparation of beer. In no instance was there evidence of dilution in the samples of beers taken from the premises of publicans or other retailers for the purpose of checking dilution and adulteration. Seventy-seven samples were submitted as non-alcoholic beers under Section 8 of the Finance Act (Sess. 2), 1914, which exempts from duty beers which are not brewed on licensed premises, if the original gravity and proof-spirit do not exceed 16° and 2 per cent. respectively. In four cases the proof-spirit was between 3 and 4 per cent., and in one instance it exceeded 5 per cent. Owing to the restrictions caused by the war, the importation of beer has almost ceased, and very few samples were examined. *Examination of Beer and Brewing Materials for Arsenic.*—The total number of samples tested, including beer, worts, malt, sugar, and other materials used in brewing was 1,249. Of these, eight were found to contain arsenic in excess of the limits suggested by the Royal Commission on Arsenical Poisoning—namely, the equivalent of $\frac{1}{100}$ grain of arsenious oxide per pound in the case of solids, or per gallon in the case of liquids. Of 205 samples of malt and sugar tested, none contained arsenic in excess of the limits. Nine hundred and sixty-six samples of beer and wort examined were also free from arsenic. The samples in which excess of

arsenic was found consisted of salts and solutions proposed to be used for treating brewing waters, but in no case was arsenic, in excess of the Royal Commission limits, found in samples of beer made with water so treated.

CIDER AND PERRY.—Eighteen samples of imported cider were examined, all of which were of normal character. Ten samples were purchased by Customs and Excise officers in the United Kingdom, of which four were factitious—that is to say, did not consist solely of fermented apple-juice. The six genuine ciders contained 3 to 6 per cent. of proof spirit. Six samples of sour ciders were also submitted for examination in order to obtain remission of the duty. All were found to contain sufficient acid to render them unsaleable as commercial ciders.

TABLE-WATER DUTY.—The Finance (New Duties) Act, 1916, and the Finance Act, 1916 (6 Geo. V., c. 2, and 6 and 7 Geo. V., c. 24), imposed Excise and Customs duties on "Table Waters" at rates varying from 2d. to 8d. per gallon. In order to determine the question of liability to duty, six samples of mineral and spa water, 135 samples of cordials, syrups, fruit juices, and essences, and forty-two samples of "non-alcoholic" wines were examined. Of the six waters, five proved to be medicinal, and one was liable to table-water duty; twelve of the so-called "non-alcoholic" wines contained more than 2 per cent. of proof spirit, and one herbal preparation, which the vendors claimed was not a beverage, but a *bona-fide* medicine, proved to be sufficiently medicated to exempt it from table-water duty.

SPIRITS.—*Illicitly Distilled Spirits*: Thirty-one samples of spirits suspected to have been obtained by illicit distillation were examined during the year, and in fifteen instances strong evidence of the presence of illicit spirit was obtained. The latter samples were taken from two sets of premises, where, on investigation, it was evident that illicit distillation had been carried on. *Imported Spirits and Spirituous Preparations*: The number of samples examined was 11,444, a further decrease on last year's numbers, though in spirits, as distinct from spirituous preparations, the number of samples was doubled. This was no doubt due to the fact that a shortage of spirit existed up to the date of the Armistice, shipping space being found, however, for the pure spirit required in such large quantity in connection with the production of munitions. When necessary, the amount of sugar, saccharin, and other dutiable ingredients in the imported preparations was also determined.

More than 1,000 papers were dealt with relating to applications received by the Commissions of Customs and Excise, either (1) in respect of claims for rebate on alcohol used in making medicinal preparations; or (2) in connection with permission to receive methylated spirit and other forms of duty-free alcohol for use in manufactures, tuition and research. In the former instances advice was required as to whether the claims in question were such as could properly be allowed under Section 4 of the Finance Act, 1918.

WINES.—The number of samples examined in connection with the assessment of the Wine Duties was 84,796, including a few samples of unfermented grape-juice and medicated wine. In addition to the samples of so-called wine dealt with as table-waters, one sample of medicated wine and nine of British wines or sweets

were also examined to settle questions of exemption or of liability to licence duty in connection with sales. Of ordinary wine, there was a very largely increased importation, more than 40,000 additional samples having been examined, for the most part after the date of the Armistice.

TOBACCO.—*Manufactured Tobacco for Home Consumption*: To ensure observance of the regulations as to moisture and oil, which are based upon the provisions of the Customs and Inland Revenue Act, 1887, the Oil in Tobacco Act, 1900, and the Finance Act, 1904, samples are taken from the factories and from the premises of retail dealers by Customs and Excise officers, and examined at the Government laboratory. *Manufactured Tobacco and Commercial Snuff on which Drawback is claimed on Exportation*: The samples of tobacco exported on drawback numbered 27,123, as compared with 30,564 received during the previous year. The volume of the export trade in commercial snuff is small, the number of the samples of this kind received being only 133, or 20 less than in the year 1917-18.

SUGAR, GLUCOSE, AND SACCHARIN.—*Sugar*: The variety of preparations containing sugar is so great that it has been found necessary to adopt fixed rates of duty in the case of those which are regularly imported or which are exported on drawback, samples being examined only in cases of doubt as to their description or rating for duty purpose. *Glucose*: Glucose manufactured in this country is subject to an Excise duty. In connection with the assessment of this duty 266 samples of glucose solution taken from the charging vessels during the course of manufacture were examined in order to check the manufacturers' declarations, and 42 for assessment of drawback on exportation, together with 73 of glucose used in syrups made at sugar refineries. *Saccharin*: The manufacture of saccharin in the United Kingdom, which had ceased for some years, was resumed in 1917, and 165 samples of saccharin and of the materials used in its production were examined in connection with the assessment of duty.

TEA.—During the year under revision the inspection of tea on importation was undertaken by the Ministry of Food. Only in the case of tea which had not passed into consumption for any reason (*e.g.*, broken packages, damaged tea, etc.) were samples committed to the Government laboratory. Hence the high proportion of samples rejected as unfit for human consumption, viz., 4,862 out of a total of 7,987 samples submitted, or approximately 60 per cent. The quantity of tea represented by these samples was insignificant compared with the total quantity passed by the Tea Controller for home consumption.

MATCHES.—The imports of matches in 1918-19, though larger than in the previous year, were still much below pre-war level, and only three samples were submitted under the "White Phosphorus Matches Prohibition Act, 1908," in none of which was any evidence of the presence of white phosphorus discovered.

BOARD OF AGRICULTURE AND FISHERIES.—The number of samples examined for the Board of Agriculture and Fisheries, the Board of Agriculture for Scotland, and

the Department of Agriculture and Technical Instructions for Ireland, was 581 as compared with 1,568 in the previous year. Samples of imported dairy produce and margarine are taken at the ports of Customs and Excise officers in accordance with the provisions of the Sale of Food and Drugs Act, 1899, and the Butter and Margarine Act, 1907. The number includes the samples taken under the Public Health (Milk and Cream) Regulations, 1912 (see Local Government Board—Preservatives). *Imported Milk and Cream.*—During the past year no samples of fresh or of sterilised milk were examined. The description “condensed milk” is usually applied to milk from which water has been removed by evaporation to such a degree that one part by weight of the condensed product contains the milk solids of two and a half to three parts of the original milk. This condensed milk is liquid, and, if it has not been sweetened, contains from 64 to 68 per cent. of water. It frequently, however, contains 40 per cent. of sugar with only 24 to 29 per cent. of water. The condensed unsweetened milk prepared in America is usually described as “evaporated” milk. This consists of milk which has been evaporated to about half its bulk, and one part by weight therefore contains the milk solids of only two parts of the original milk. The proportion of water is from 74 to 77 per cent. Of late years condensed milk has also been prepared in which the removal of the water has been carried much farther, leaving the milk solids in a nearly dry condition. This product, which is variously described as “dried milk” or “milk powder,” contains the milk solids of seven or eight times its weight of whole milk, or, when prepared from skimmed milk, the milk solids of nine to ten times its weight of skimmed or separated milk. The water in “milk powder” varies from 2 to 8 per cent. The object of the examination is to ascertain whether the milk has been prepared from impoverished, skimmed, or separated milk, in which cases the product can only be imported in receptacles marked in accordance with the requirements of the Food and Drugs Act. The samples are also examined for preservatives (ANALYST, 1918, 43, 239). Of 51 samples of condensed, sweetened, and unsweetened milk, 47 were condensed whole milk, and 4 condensed skim milk. Three of the packages were not marked as required by law. The percentage of fat in the samples of condensed whole milk ranged from 7.2 to 9.9. The samples with the low percentage of fat were taken from consignments of “evaporated” milk, 30 of the 47 samples consisting of this product. All the samples were free from preservatives, and there was no evidence that the samples of condensed whole milk had been prepared from impoverished or skimmed milk. No samples of dried milk were examined; no samples of cream were received during the year. *Imported Butter.*—Only 20 samples of imported butter were examined as compared with 431 in 1917-18 and 892 in 1916-17. Of the 20 samples, 14 were from Denmark, 4 from the United States, 1 from Australia, and 1 from the Argentine. The samples were examined in every case as to the purity of the fat and the presence of boric acid and added colouring matter. The water was also determined, but no sample was found to contain water in excess of the legal limit of 16 per cent. There was no evidence of the presence of any other fat than butter in any of the samples. *Imported Margarine.*—No samples of imported margarine were examined. *Imported Cheese.*—Of the 12 samples of imported cheese examined

all proved to be genuine. *Questions submitted by the Board for Report.*—In the course of the past year numerous matters have been submitted by the Board for report. Many of these related to the value of materials supplied as feeding-stuffs, and to the supply of potash and phosphatic manures. The official method for the determination of potash in fertilisers has been revised and a new method drawn up for use in the case of flue dust (F. and F. Stuffs [Methods of Analysis] Regulations, No. 659, 1918). Reports on Paisley meal, butter-milk, and fish meal, have been made to the Board of Agriculture for Scotland.

A description is given of the work done for the Fisheries Division, Central Control Board (Liquor Traffic), Crown Agents for the Colonies, Food Ministry, Home Office, India Office, Inland Revenue, Local Government Board, Ministry of Munitions, Post Office, Public Record Office, Stationary Office, Board of Trade, Coal Controller, War Department and Office of Works.

Under the Local Government Board are mentioned samples of chocolates containing mercury derived from the tin trays in the process of manufacture, and a case of pastry made with a self-raising flour in the preparation of which tartar emetic had been used in the place of tartar substitute (acid phosphate of lime).

SALE OF FOOD AND DRUGS ACT.—Examination of samples referred by Magistrates under the Sale of Food and Drugs Acts of 1875 and 1899, and under Food Control Orders.—When proceedings are taken under these Acts, either the prosecutor or the person charged may request the justices before whom the case is heard to forward a portion of the sample in question to the Government Laboratory for analysis. Under these provisions 97 samples were received as compared with 102 in the previous year. These included 82 samples of milk; 3 of whisky; 2 each of ginger, Epsom salts and dripping; and 1 each of lard, cheese, chocolate, beer, camphorated oil and sausages. Five samples could not be examined owing to their condition on receipt. The results of the examination differed from those of the Public Analyst in 12 out of the 92 cases, or 13 per cent., as against 13·5 per cent. in the previous year. The disagreements in respect of milk samples were 5 out of 82. The following are the particulars of some of the most important cases: *Whisky.*—The results as to the strength confirmed those of the Public Analyst in 2 cases, but differed in 1 case. *Epsom Salts.*—One sample contained arsenic, and the other was impure, as alleged by the Public Analyst. *Dripping.*—The results showed that both samples, which were alleged to be tallow, came within the description of dripping as defined by the Food Control Order. In the case of ginger alleged to contain foreign starch, chocolate alleged to be deficient in cocoa powder, beer alleged to have a low original gravity, the results did not agree with those of the Public Analyst. In the case of camphorated oil alleged to be deficient in camphor, lard alleged to be beef or mutton fat, cream cheese alleged to contain boric acid, and sausages alleged to be deficient in meat, the results agreed with those of the Public Analyst. In the 77 cases in which certificates were issued, the charges were as follows: In 44 cases, added water; 22, abstraction of fat; 8, added water and abstraction of fat; 2, presence of pre-

servatives ; and 1, presence of dirt. Boric acid was also alleged to be present in one of the samples.

FERTILISERS AND FEEDING STUFFS ACT.—The five fertilisers examined consisted of superphosphate, basic slag and sulphate of ammonia. The six feeding stuffs consisted of feeding meals and cakes, milling by-products and poultry foods. Several of the meals contained a considerable proportion of substances unsuitable for feeding purposes.

H. F. E. H.



REVIEW.

THE BACTERIOLOGY AND MYCOLOGY OF FOODS. By FRED WILBUR TANNER, M.S., PH.D.
New York: John Wiley and Sons. 1919. Pp. 592. London: Messrs. Chapman
and Hall, Ltd. Price 28s.

In this treatise the author has attempted to cover a very wide field, and one in which there is much room for improvement in both knowledge and method. After eight chapters dealing with the technique of bacteriological analysis and the general description of yeasts, moulds, and bacteria, and the chemistry of food materials, there follow chapters on the bacteriological examination of Air, Water, Milk and its Products, Eggs, Meat and Meat Products, Canned Foods, etc. The work is almost entirely a compilation from various sources, chiefly American, and though in the preface the author states that the methods of analysis have been presented together with a discussion based on the literature of the subject, this discussion is of the nature of an epitome of the views of others rather than a presentation of the author's own opinion on the various subjects.

In these days, when the volume of scientific literature is becoming so large, it is true that an accurate compilation is often of great value; but it is absolutely necessary that such a compilation should be very carefully made, and it is disappointing, after reading with pleasure in the opening paragraph of the Preface that "a thorough training in chemistry is essential for intelligent work in microbiology"—a sentiment which the reviewer must cordially echo—to find that the chemist's sense of accuracy and attention to detail is singularly lacking in the reproduction of the subject-matter.

For instance, the author has accumulated in one chapter practically every medium which has been proposed for the cultivation of micro-organisms, but no attempt has been made to present them in a form which would render their preparation reasonably possible in many cases, and the necessary context of the original has too often been omitted. As an example the preparation of malachite green media (p. 52) may be quoted:

1. Three grms. Liebig's Meat Extract.
2. Acidify this with 7.5 c.c. $\frac{1}{4}$ HCl.
3. Dissolve 30 grms. of agar by boiling.
4. Neutralise with 7 c.c. $\frac{1}{4}$ NaOH until neutral to litmus.
5. Add 5 c.c. $\frac{1}{4}$ Na_2CO_3 and heat in an Arnold for several hours. A somewhat difficult proceeding!

In the directions for the preparation of media the words "slightly alkaline" or "absolutely neutral" often occur, and such terms should have no place in any modern method of preparation. In some cases the reaction is given as +1, +0.5, etc., but nowhere are any directions given for the determination of this reaction, nor is any explanation of the symbols vouchsafed.

The same faults appear in the sections dealing with methods of staining. A very fine collection of methods has been very inadequately reproduced. For such an excellent method as the Indian ink method the reader is simply directed to "mount in Chinese ink," and, though the author states that he has secured the best results for flagella staining with Loeffler's method, and gives the composition of both mordant and stain, he entirely omits to use the former in his description of the staining process. Other instances of this carelessness are only too common. The chapters on water and milk examination contain much useful information, together with full descriptions of the American official methods, but a good deal of space is allotted to chemical analysis, which hardly appears to come within the scope of the work.

The section dealing with eggs includes an account of work which has hitherto been hidden away in official bulletins, and this has been carefully collected here, but the coloured plates in this section have suffered in reproduction, and comparison with the explanations in the texts shows that they call for much imagination on the part of the reader.

There is no doubt that there is a great deal of information contained in this work, but it has not received the consideration it deserves in its reproduction, and at the same time there is much which, however useful, has little or no bearing on the subject-matter of the book. An illustration of this is afforded by an appendix of tables of figures, some of which are quite in their proper place, but with them are included those which give areas and circumferences of circles, water pressures at different heads, etc.; together with such unusual information as the relation between Kokus and Bedeps, the number of square miles in a township, etc.

The wording of the book is decidedly American, but this should not be carried to such an extent as to take liberties with such revered names as those of Twaddell.

The text is much marred by typographical errors, which are undoubtedly the result of careless proof-reading.

To the expert reader this work may be of interest, as the author has certainly collected together a great deal of information, the value of which is enhanced by the bibliography (chiefly American) attached to each chapter, but to the student the unreliability of the text renders it an unsafe guide.

CECIL REVIS.
