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THE ANALYST

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

AN Ordinary Meeting of the Society was held in the Chemical Society's Rooms, Burlington House, on Wednesday, October 3rd, the President, Mr. Edward Hinks, being in the chair.

Certificates were read for the first time in favour of:—Charles Wesley Bayley, Harry Brindle, B.Sc., A.I.C., William George Burgess, Albert Clarke, George Leonard Clothier, Hector Ingram Downes, M.Sc., A.I.C., Alec Walter Greenhill, M.Sc., A.R.C.Sc., A.I.C., Donald R. Hayward, B.Sc., B. L. Khuller, M.Sc., A.I.C., James Donald Kidd, B.A., M.Sc., A.I.C., Herbert Drake Law, D.Sc., F.I.C., Sidney John Saint, B.Sc., A.I.C.

Certificates were read for the second time in favour of:—Bhagwat Prasad Bhargava, B.Sc., Cyril Ernest Gill and Thomas Percy Hilditch, D.Sc., F.I.C.

The following were elected Members of the Society:—Arthur Duncan Gay, John Gordon Mayne, Reginald Arthur McNicol, M.Sc., A.I.C., William Ramsden Orrell, B.Sc., A.I.C., Laurence Frederick Smith, M.Sc., A.R.C.S., A.I.C., Charles Frederick Turner, F.I.C.

The following papers were read and discussed:—"Polarimetric Determination of Sucrose in Milk and Sucrose Mixtures," by G. W. Monier-Williams, O.B.E., Ph.D., F.I.C.; "The Analysis of Starch Sugar Degradation Products by Selective Fermentation," by T. McLachlan, F.I.C.; and "Investigations into the Analytical Chemistry of Tantalum, Niobium and their Mineral Associates. XIII. A New Method for the Separation of Zirconium and Hafnium from Tantalum and Niobium" (Work done under the Analytical Investigation Scheme), by W. R. Schoeller, Ph.D., and E. F. Waterhouse.

Obituary.

ALFRED SMETHAM.

ABOUT the year 1875 there were, working side by side, in a chemical laboratory in London, just out of Fleet Street, three young men who were qualifying themselves for pursuing a professional career in the domain of agricultural chemistry. This was a new branch in this country—one introduced by their then teacher, the late Dr. Augustus Voelcker, from whom they drew their inspiration and to whom each was alike devoted. These three were Alfred Smetham, Bernard Dyer and the present writer, and the warm friendship then formed has lasted unbroken until now, and has ever been marked by a fellowship in aim and community of interests.

The death, on October 11th, of Alfred Smetham, at the age of 71, makes a break in the long association, and has left now but two or three who worked under the distinguished teacher and exponent. Smetham was ever ready to acknowledge his indebtedness to his early training under Dr. Voelcker, for whom he held the deepest regard.

Alfred Smetham was born in December, 1856, the second son of a remarkable man, James Smetham—an artist of the pre-Raphaelite school, and a personal friend of Rossetti, Ruskin and others of that day, and whose letters (first published in 1891 and since re-printed) are of exceptional beauty and full of artistic feeling. Coming, on Sir Henry Gilbert's (Rothamsted) introduction, to Dr. Voelcker in 1873, Alfred Smetham became his assistant and remained with him until 1879, when he left to make a start for himself in Liverpool, a place which seemed to offer an opening for the then new line of agricultural analyst. Nor was Smetham mistaken in this, for, after some few years of up-hill work, he succeeded in establishing himself firmly, enjoying an excellent practice which gave him the leading position as an agricultural chemist and analyst in Liverpool and the north-west of England generally. In this he was aided greatly, at the outset, by being appointed Consulting Chemist to the Royal Manchester, Liverpool, and North Lancashire Agricultural Society (subsequently the Royal Lancashire Agricultural Society). For this Society he carried out, in the earlier days, a considerable amount of research work, chiefly in connection with cheese-making and dairy matters generally, and with the field and other experiments of the Society. Among the members of this Society he had many and firm friends, and by all alike was held in high esteem.

But his energies and his reputation as a sound chemist and careful analyst, as well as a man of honour and uprightness, led to his finding a much wider sphere than that of strictly agricultural work, and it was not long before he had built up a large commercial practice concerned with the principal imports of which Liverpool is a shipping centre. The cotton-seed, the palm-nut and other industries

came his way, and he was soon the recognised authority on chemical matters arising from these. His reputation as a careful analyst and man of integrity continued to the end.

While the responsible duties attaching to the maintaining of such a practice naturally prevented his carrying on his earlier work of research, Smetham interested himself greatly in the work of the local branch of the Society of Chemical Industry, of which he was Chairman in 1899 and 1900. The Society of Public Analysts was another to which he was much attached, and, after serving for four different periods on the Council and for one as Vice-President, a fitting tribute was paid to him when, in 1920, he was chosen as President. Despite the distance from London, he attended the meetings during his term of office with unfailing regularity, and guided the affairs of the Society with ability, judgment and enthusiasm.

He contributed many papers to the proceedings of our Society, mainly in its earlier years. His papers—to be found in THE ANALYST (chiefly in the earlier volumes)—dealt with the estimation of phosphoric acid; a (then) new method for the estimation of carbon in potable water by moist combustion; the efficiency of centrifugal cream separators; a new apparatus for fat estimation in liquids; saponification of fats; notes on rice oil and maize oil; the value of the nitrogen factor in the analysis of decomposed milk; some properties of rosin; and abnormal butter. A more recent contribution, and one of special value, appeared in THE ANALYST of 1927 (Vol. LII, p. 273), detailing the results of feeding experiments made in conjunction with Mr. Stafford Jackson (veterinary surgeon) on the effect of corn cockle (*Agrostemma githago*) on pigs. This investigation had been made some few years earlier in connection with a legal case, and was later recorded in THE ANALYST as affording evidence sufficiently cogent to abolish the long current notion that the occurrence of small quantities of cockle in wheat offals is capable of producing toxic effects on pigs.

To the journals of the Royal Lancashire Society he contributed each year a paper on some subject of chemico-agricultural interest at the time, and among these will be found many useful practical points, including the valuation of foodstuffs and fertilisers, unexhausted manure values, etc. Especially useful to agricultural analysts is a detailed list of analyses of agricultural products, both home and foreign, which he compiled from the wide experience he had personally gained in the examination of these materials. He was elected a Fellow of the Chemical Society in 1875, and a Fellow of the Institute of Chemistry in 1878, subsequently serving on the Council of the latter body for three separate periods.

His practice engaged his main attention, and, although in his youth he was a keen football player, recreation, sport, and public affairs played but a small part in his life. But to those who knew him he was an ever loyal friend, one marked by his high sense of duty, and one always ready to place his special knowledge at the disposal of his professional brethren.

He was twice married, but leaves no family. Up to comparatively lately he enjoyed good health, but a breakdown recently occurred, and his death occurred from pneumonia after a few days' illness. The funeral took place at Rockferry on October 15th in the presence of a large gathering of friends and clients, including his partner, Mr. Robertson Dodd, F.I.C., his old pupil, Captain Tunstall-Behrens, and numerous other professional colleagues. The Society of Public Analysts was officially represented by his life-long and intimate friend Dr. Bernard Dyer, the Institute of Chemistry by Professor W. H. Roberts, and the Society of Chemical Industry by Mr. E. Gabriel Jones.

J. AUGUSTUS VOELCKER.

MAURICE SALAMON.

THE death of Maurice Salamon will be very deeply regretted by a wide circle of professional and personal friends. I knew Salamon very intimately, and he used, on those occasions when we could both spare an hour or so to lunch together, to give me a good deal of his confidence. I do not know whether or not it had anything to do with his early death, but I always told him he was working too hard. His energy was immense, and as he was of a rather "nervy" temperament, he would worry very greatly over trifles. Indeed, I often told him that if he couldn't find a worry he would manufacture one.

Salamon had the confidence of the wax trade in Mincing Lane, and was, of course, well known in connection with essential oils and agricultural products.

Born about 40 years ago—I could never ascertain his exact age—he was educated at University College, and took a Science degree at London University. He was the senior partner in the three firms: Salamon and Seaber, Halse and Marshall, and John Hughes. In connection with the last-named, which he took over on the death of John Hughes, he became official analyst to the London Cattle Food Trades Association, and was on the panel of Analysts of the London Oil and Tallow Trades Association. He was an excellent witness, obviously impressing the Judge by his impartiality.

He published numerous papers on the analysis of essential oils and waxes, and was at the time of his death doing much work for the Sub-Committee of the Standing Committee of the Society of Public Analysts on the standardisation of essential oil analysis.

Apart from the high esteem in which he was held professionally, he made firm friendships, and will be badly missed by many of us, not least of all by

ERNEST J. PARRY.

WILLIAM PLENDERLEITH LEWELLEN HOPE.

By the untimely death of William Plenderleith Lewellen Hope at the early age of 27 years the Society has lost a young member of great promise. Son of the late Mr. H. N. Hope, he was born at Las Palmas, Grand Canary, on December 1st, 1900, was educated at George Watson's College, Edinburgh, and, having gained the higher certificate there, passed in 1917 into Edinburgh University, where he graduated B.Sc. at the age of 19 years. In the autumn of 1918 he spent some time in the laboratory of Messrs. John Knight Ltd., Silvertown, of which firm his uncle, Mr. J. W. Hope, was then chairman, afterwards returning to Edinburgh, and in 1920 became assistant to the late Otto Hehner, continuing with the writer until he died suddenly on August 28th, victim of an unsuspected disease. He was elected A.I.C. in 1922, became a member of this Society in February, 1923, and having passed the examination in Branch E, became a Fellow of the Institute in 1926.

Hope was one of a type of young chemist we can ill afford to lose; he was not only a capable accurate analyst, a genial cheery colleague, but was mentally very alert and versatile, taking a keen interest in other branches of science and in affairs in general and chemical in particular. Had he lived longer he would probably have become one of the leaders of our profession. He was of the strictest probity, and his devotion to his mother, his constant companion, was in itself an indication of the character of the man. The funeral took place at Kensal Green on August 31st, the Society being represented by Mr. Eric Voelcker and the writer.

H. E. Cox.

Polarimetric Determination of Sucrose in Mixtures of Milk and Sucrose.

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

(*Read at the Meeting, October* 3, 1928.)

The following method is based on the work of R. F. Jackson and C. L. Gillis (*Sci. Paper*, No. 375, U.S. Bureau of Standards, 1920), and on the observations of W. C. Vosburgh (*J. Amer. Chem. Soc.*, 1920, **42**, 1696) and of F. W. Zerban (*J. Amer. Chem. Soc.*, 1925, **47**, 1104) on the effects of concentration and temperature on the specific rotation of invert sugar. Angular degree notation is used throughout as being more suitable for general work than the saccharimetric notation employed by most sugar chemists. The application of a correction for the volume occupied by proteins and fat is obviated by determining the total water present in the diluted milk and sucrose mixture, defecating with dry reagents, and subsequently determining the ratio of sucrose to water in the clear filtrate.

The polarimeter used in the work recorded below was a Schmidt and Haensch instrument with Lippich triple field polariser. The source of light was a sodium

flame, produced by a bead of sodium carbonate on a platinum wire loop in a Bunsen flame, and the light was filtered through a 3 cm. layer of $N/10$ potassium dichromate, although this precaution is hardly necessary. The sucrose used was the A.R. quality supplied by British Drug Houses Ltd.

A determination of total solids is carried out on the milk and sucrose mixture by the Milk Products Sub-Committee's method (ANALYST, 1927, **52**, 403), and from this the percentage of water present is calculated. In the formula given below this percentage is represented by x. (In the actual case of a condensed milk, the total solids of which have been determined by the Committee's method, a known weight of condensed milk is diluted with a known amount of water to about three times its weight, the usual precautions being taken to ensure solution of lactose, and the percentage of water in the mixture is calculated.)

Approximately 350 grms. of the milk and sucrose mixture, weighed to 0·1 grm., are treated with 1·5 grm. of (powdered) citric acid, which coagulates the casein. The coagulated milk is shaken, and to it is added, in small portions at a time, a mixture of 9 grms. of phosphotungstic acid and 45 grms. of dry sand, the two having been previously ground together in a mortar. If more or less of the milk and sucrose mixture be taken, the amounts of citric and phosphotungstic acids are varied accordingly. The quantity of citric acid added should be that necessary to coagulate the casein, and of phosphotungstic acid that necessary to effect complete precipitation of proteins while leaving a slight excess of phosphotungstic acid in solution. The liquid is thoroughly shaken after each addition of phosphotungstic acid and sand. The object of the sand is to effect fine sub-division of the phosphotungstic acid crystals, and to assist in breaking up the curd during the subsequent shaking.

The liquid is then filtered through a dry folded filter, the first runnings of the filtrate being rejected. A total solids determination is carried out on the filtrate by the Committee's method (see note 5 below).

Fifty c.c. of the clear filtrate are measured into a dry weighed 100 c.c. measuring flask, and the weight ascertained. From the total solids determination the actual weight of water in this 50 c.c. is calculated (y in the formula below). To the 50 c.c. of filtrate are added 2·675 grms. of dry ammonium chloride, and the contents of the flask made up to the mark, allowed to stand for one hour, and polarised in a 200 mm. water-jacketed tube. The temperature of the liquid should be between 18° and 22° C., and should be recorded to within 0·2° C. by means of a small thermometer placed in the opening of the jacketed tube. The thermometer is allowed to remain in the liquid until the temperature indicated is constant, and is then withdrawn immediately before the readings are taken. The mean of the readings is represented by A in the formula below.

A second portion of 50 c.c. of the filtrate is measured into the same 100 c.c. flask with the same pipette, and exactly 10 c.c. of 5 N hydrochloric acid are added. The mixture is placed in a water bath at 60° C. for 12 minutes, the flask being agitated for the first 4 minutes to promote rapid heating. It is then withdrawn

and cooled, and 10 c.c. of 5 *N* ammonia solution added slowly, with shaking, from a burette. The ammonia solution need not be exactly 5 *N*, but its strength in terms of 5 *N* hydrochloric acid must be known, and an amount added just sufficient to neutralise the hydrochloric acid used. The contents of the flask are again cooled, if warm, and made up to the mark. Sometimes the solution after addition of ammonia is clear, at other times it becomes cloudy, or an actual precipitate of tungstic acid may be formed. The formation of this precipitate seems to depend largely on how the ammonia is added. It does not appear to affect the accuracy of the determination.

If the solution be cloudy it must be filtered through a dry filter before polarisation, the first runnings being rejected. It is then allowed to stand for one hour and polarised in the same way and at as nearly as possible the same temperature as the uninverted solution. Accurate measurement of the temperature is particularly important in this case. A convenient device for maintaining a constant temperature between 18° and 22° C. is shown below.

The mean of the readings is represented by B in the formula below, and A—B is the change of rotation on inversion of the filtrate as diluted for polarisation.

The percentage of sucrose in the milk and sucrose mixture is then given by the formula—

$$\frac{A-B}{87{\cdot}9+0{\cdot}06c-0{\cdot}3(t-20)} \times \frac{100}{2} \times \frac{x}{y},$$

where c is the percentage concentration of *total* sugars in the inverted solution, as diluted for polarisation; t is the temperature of invert polarisation; A is the direct reading of the filtrate as diluted for polarisation; B is the invert reading of the filtrate as diluted for polarisation; x is the percentage of water by weight in the diluted condensed milk or milk and sucrose mixture; y is the weight of water in the 50 c.c. of filtrate taken for polarisation.

Determinations of sucrose in milk and sucrose mixtures by this method gave the following results:

Per cent. sucrose added to milk.	Per cent. sucrose found.	Error. Per Cent.
13·44	13·50	+·06
13·77	13·82	+·05
12·64	12·68	+·04
8·65	8·68	+·03
19·99	19·92	—·07

When referred to condensed milk with 40 per cent. of sucrose, the above results would represent errors of +0·18 to —0·14 on the percentage of sucrose present. An actual determination, showing the calculations involved, is given below.

NOTES ON THE METHOD AND ON THE DERIVATION OF THE FORMULA.

1. *Inversion at* 60° *C.*—This is in accordance with Jackson and Gillis's recommendation. They found that there is much less likelihood of destruction of laevulose at 60° C. than at 70° C.

2. *Strength of Hydrochloric Acid and Time of Inversion.*—Jackson and Gillis took 70 c.c. of solution for inversion and added 10 c.c. of 6·34 *N* hydrochloric acid, which has a density of 1·1029 at 20°/4° C., and which contains 20·97 per cent. of hydrochloric acid by weight and 23·12 per cent. by volume. The actual per cent. by volume (grms. HCl per 100 c.c.) in the liquid during inversion was therefore 2·89 per cent. It is simpler, for manipulative reasons, to measure 50 c.c. of liquid into the flask and add 10 c.c. of 5 *N* hydrochloric acid, which gives 3·04 grms. of hydrogen chloride per 100 c.c. of total liquid during inversion. The strength of hydrochloric acid is thus somewhat higher than that used by Jackson and Gillis, but part of the acid probably reacts with citrates, phosphates and other salts in the milk filtrate, which reduces its effective strength.

Jackson and Gillis inverted for 9 minutes at 60° C., whereas I have adopted 12 minutes, in view of the results obtained in the following experiment :

Two hundred c.c. of milk + 1 grm. citric acid + 6 grms. phosphotungstic acid (with sand) were shaken and filtered, and 15 grms. of sucrose were dissolved to 100 c.c. in this filtrate. Fifty c.c. of the solution were inverted with 10 c.c. of 5 *N* hydrochloric acid at 60° C., and successive portions of 10 c.c. were withdrawn at various times, treated with the correct amount of ammonia, diluted to 25 c.c. and polarised. The polarimetric readings were as follows:

Time of inversion in minutes.	Temperature of polarisation. °C.	Reading.
5	19·5–19·6	−0·25°
8	19·6	−0·39°
11	19·6	−0·42°
14	19·7	−0·39°
17	19·7–19·8	−0·38°

It would seem therefore that, under the above conditions, the maximum of inversion combined with the minimum destruction of laevulose is reached in about 11 minutes.

3. *Neutralisation of inverted solution and addition of ammonium chloride to the direct rotation liquid.*—The object here is to carry out both the direct and invert polarisation under as nearly as possible the same conditions of acidity, concentration and salt content, so that any optically active substances other than sucrose and invert sugar will exert the same effect in both polarisations.

The addition of 2·675 grms. of dry ammonium chloride to the filtrate for direct polarisation balances the 10 c.c. of 5 *N* hydrochloric acid + 10 c.c. of 5 *N* ammonia added during the inversion process.

C. L. Hinton and T. Macara (ANALYST, 1927, **52**, 668) found that the sucrose in milk filtrates prepared by means of phosphotungstic acid underwent gradual inversion on standing. This was probably due to the free hydrochloric acid in the protein precipitant used by them. When prepared according to the formula given on page 677 of their paper, the precipitant would contain free hydrochloric equivalent to about *N*/5 strength in addition to the phosphotungstic acid present.

Filtrates prepared with solid citric and phosphotungstic acids showed no appreciable inversion at room temperature, even after standing for several hours.

The stabilisation effects noted by Hinton and Macara when using the "neutral" process do not cause trouble if the solutions be allowed to stand for an hour before polarisation. The readings obtained both for the direct and invert polarisation remain constant after sufficient time has been allowed for equilibrium to be attained.

4. *The Divisor* $(87{\cdot}9+0{\cdot}06c-0{\cdot}3(t-20°))$.—The divisor may be considered as being composed of a positive component, the $(\alpha)_D$ of sucrose, and a negative component, the $(\alpha)_D$ of the products of inversion of sucrose, referred to the original sucrose. The specific rotation of invert sugar for sodium light, according to F. W. Zerban (*loc. cit.*) is:

$$(\alpha)_D^t = -(19{\cdot}415+0{\cdot}07065c-0{\cdot}00054c^2)+(0{\cdot}283+0{\cdot}0014c)(t-20);$$

where c = grms. of invert sugar per 100 c.c., and t = temperature of polarisation. Since one part of sucrose gives, on inversion, 1·0526 parts of invert sugar, the negative component of the divisor, *i.e.* the $(\alpha)_D$ of the inversion products of sucrose, referred to the original sucrose, is obtained by multiplying the above expression throughout by 1·0526, and we have:

$$-(20{\cdot}43+0{\cdot}074c-0{\cdot}00057c^2)+(0{\cdot}3+0{\cdot}0015c)(t-20).$$

The effect of concentration and temperature on the $(\alpha)_D$ of sucrose, the positive component of the divisor, is small enough to be neglected for most purposes, so that the divisor becomes

$$66{\cdot}50+20{\cdot}43+0{\cdot}074c-0{\cdot}00057c^2-(0{\cdot}3+0{\cdot}0015c)(t-20).$$

Since the solutions polarised both contain ammonium chloride, the effect of this on the rotation must be taken into account. If m be the percentage of ammonium chloride in the solution, the specific rotation of sucrose is diminished by 0·1124 m, and that of invert sugar increased (additional laevo-rotation) by 0·3744 m (Jackson and Gillis, *loc. cit.*). As both solutions here in question contain 2·675 per cent. of ammonium chloride, the combined correction is

$$-(0{\cdot}1124\times 2{\cdot}675)+(0{\cdot}3744\times 2{\cdot}675),$$

which is exactly equal to +0·7.*

The fully corrected divisor is therefore:

$$66{\cdot}50+20{\cdot}43+0{\cdot}7+0{\cdot}074c-0{\cdot}00057c^2-(0{\cdot}3+0{\cdot}0015c)(t-20);$$

or:
$$87{\cdot}63+0{\cdot}074c-0{\cdot}00057c^2-(0{\cdot}3+0{\cdot}0015c)(t-20),$$

where c = concentration of *total* sugars in the solution polarised, and t = temperature of polarisation.

* Jackson and Gillis give their results in saccharimetric notation (Ventzke scale), and I have therefore recalculated them into angular notation.

It should be noted that the concentration (c) is that of total sugars in solution and not that of invert sugar or laevulose alone. The specific rotation of laevulose in the presence of other sugars is that which the laevulose would have in concentration equal to that of the total sugars present. This was established by Vosburgh (1920) for mixtures of laevulose and dextrose (invert sugar), and it would seem that it is also valid, within the limits of experimental error, for mixtures of laevulose with sucrose, lactose and commercial glucose (corn syrup). This is evident from the following experiments:

1. (*a*) A solution containing approximately 10 grms. of pure laevulose in 100 c.c. polarised $-17{\cdot}26°$ in a 200 mm. tube at 20·6° C.

   (*b*) A solution containing 10 grms. of lactose hydrate in 100 c.c. polarised $-10{\cdot}58°$ under the same conditions.

   (*c*) A solution containing exactly the same amounts of laevulose and lactose together in 100 c.c. polarised $-6{\cdot}95°$ under the same conditions.

If the rotation of the laevulose had remained unaffected by the addition of lactose, the rotation of the mixture would have been $-17{\cdot}26+10{\cdot}58=-6{\cdot}68°$. Actually it was $-6{\cdot}95°$. The difference, $-0{\cdot}27°$, is apparently the increase in rotation of the laevulose present, due to the influence of the lactose. According to Zerban's equation for the $(\alpha)^t_D$ of laevulose $[(\alpha)^t_D=-(91{\cdot}33+0{\cdot}164c-0{\cdot}00086c^2)]$ an increase in the value of c from 10 to 20 should result in an additional laevorotation of $-0{\cdot}28°$.

In a similar experiment with sucrose (15 per cent.) and laevulose (10 per cent.) the increase of rotation of laevulose due to the presence of sucrose was found to be $-0{\cdot}47°$, and from Zerban's equation it should be $-0{\cdot}40°$.

In a similar experiment with commercial corn-syrup (20 per cent. solution containing approximately 16 per cent. of sugars) and laevulose (10 per cent.) the increase of rotation of laevulose due to the presence of the other sugars was $-0{\cdot}36°$, whereas according to Zerban's equation, with c representing total sugar concentration, it should be $-0{\cdot}43°$.

The close agreement in the case of lactose, as compared with the other sugars, is possibly due to the fact that the rotations of sucrose and dextrose are themselves slightly affected by varying concentration, whereas that of lactose is not so affected.

It is clear therefore that c, in the formula given above for the divisor, must be the concentration of total sugars, and not that of sucrose or invert sugar alone.

The divisor $87{\cdot}63+{\cdot}074c-{\cdot}00057c^2-(0{\cdot}3+{\cdot}0015c)(t-20)$ entails a laborious calculation and is not suited for general work. Practically the same results are given by the simplified expression

$$87{\cdot}7+0{\cdot}06c-0{\cdot}3(t-20).$$

This is shown by the following figures in which the divisor has been calculated for

the long formula (column 3), and for the simplified formula (column 4), for different values of c and t.

c.	t.	Long formula.	Short formula.
5	22° C.	87·37	87·4
5	20° C.	87·99	88·0
10	18° C.	88·94	88·9
10	20° C.	88·31	88·3
20	17° C.	89·87	89·8
20	20° C.	88·88	88·9

The temperature of polarisation must be kept between 18° C. and 22° C., otherwise the short formula does not agree so well with the long one.

The degree of accuracy obtainable by the use of the short formula in the analysis of pure sucrose solutions is shown by the following examples, which are calculated out so as to give the percentage of sucrose in the sample of dry sugar taken:

(i) 20 *per cent. sucrose solution.*

Direct rotation in 200 mm. tube at 19·9° C.	+26·57
Invert ,, ,, ,, ,, ,, ,, ,,	− 9·00
Change on inversion	35·57°

$$\frac{35{\cdot}57\times 2{\cdot}5}{87{\cdot}7+(0{\cdot}06\times 20\times 1{\cdot}05)-0{\cdot}3(19{\cdot}9-20)} = 99{\cdot}92 \text{ per cent. sucrose.}$$

The term 1·05 in the divisor is introduced here, since c represents the percentage concentration of total sugars in the *inverted* solution.

(ii) 15 *per cent. sucrose solution.*

Direct rotation at 20° C.	+19·90
Invert rotation at 20° C.	− 6·66
Change on inversion	26·56°

$$26{\cdot}56 \times \frac{50}{15} = 88{\cdot}53.$$

$$87{\cdot}7+(0{\cdot}06\times 15\times 1{\cdot}05)-0{\cdot}3(20-20)=88{\cdot}64.$$

$$\frac{88{\cdot}53}{88{\cdot}64} = 99{\cdot}88 \text{ per cent. of sucrose.}$$

(iii) 10 *per cent. sucrose solution.*

Direct rotation at 20° C.	+13·29
Invert ,, ,, ,,	− 4·39
Change on inversion	17·68°

$$\frac{17{\cdot}68\times 5}{87{\cdot}7+(0{\cdot}06\times 10\times 1{\cdot}05)-0{\cdot}3(20-20)} = 100{\cdot}08 \text{ per cent. of sucrose.}$$

(iv) 5 *per cent. sucrose solution.*

Direct rotation at 19·9° C.	+6·65
Invert ,, ,, ,,	−2·16
Change on inversion	8·81

$$\frac{8{\cdot}81\times 10}{87{\cdot}7+(0{\cdot}06\times 5\times 1{\cdot}05)-0{\cdot}3(19{\cdot}9-20)} = 100{\cdot}14 \text{ per cent. of sucrose.}$$

These examples indicate the necessity of taking sugar concentration into account in order to obtain accurate results. If the divisor for a 10 per cent. solution were used for a 15 per cent. solution, the result would be 0·35 per cent. too high.

On applying the divisor $87{\cdot}7+0{\cdot}06c-0{\cdot}3(t-20)$ to solutions of sucrose in the filtrate from milk prepared as above with citric and phosphotungstic acids, slightly high results are obtained. This is probably due to the fact that the milk filtrate contains soluble salts which affect the rotation of the sugars. In the filtrate, as diluted for polarisation, there will be, very roughly, $\frac{0{\cdot}6}{2} = 0{\cdot}3$ per cent. of soluble milk salts, taking 0·6 per cent. as representing the soluble salts of milk. In addition to this, there will be a certain amount of citric and phosphotungstic acids present. It has been stated above that the figure to be added to the divisor to offset the effect of 2·675 per cent. of ammonium chloride is 0·7, and experiments on solutions of sucrose in milk filtrates have shown that an additional 0·2 must be added to the divisor to compensate, probably, for the effect of the soluble milk salts and acids present.* To this extent, therefore, the divisor for mixtures of milk and sucrose is an empirical one. In four experiments on solutions of sucrose in milk filtrates (approximately 13 to 15 per cent. of sucrose), the first term of the divisor was found to be:

(i)	87·91
(ii)	87·97
(iii)	87·83
(iv)	87·89
Mean	87·90

Using this divisor, the following results were obtained with milk filtrates to which 15·00 per cent. of sucrose had been added.

(i) Change of rotation on inversion
$=13{\cdot}24°$ at 20·75° C.

Total sugars in inverted and diluted solution = 10·3 per cent.

$$\frac{13{\cdot}24\times 100}{87{\cdot}9+(0{\cdot}06\times 10{\cdot}3)-0{\cdot}3(20{\cdot}75-20)} = 15{\cdot}00 \text{ per cent. sucrose.}$$

* Experiments on milk filtrates without the addition of sucrose showed that there is no hydrolysis of lactose during the inversion process. The rotation of the milk filtrate before and after inversion was exactly the same. The necessary addition of 0·2 to the divisor is not therefore due to any effect of the inversion process on lactose.

(ii) Change of rotation on inversion
$=13{\cdot}36°$ at $18{\cdot}35°$ C.
Total sugars in inverted and diluted solution $=10{\cdot}3$ per cent.

$$\frac{13{\cdot}36\times 100}{87{\cdot}9+(0{\cdot}06\times 10{\cdot}3)-0{\cdot}3(18{\cdot}35-20)} = 15{\cdot}02 \text{ per cent. of sucrose.}$$

(iii) Change of rotation on inversion
$=13{\cdot}34°$ at $18{\cdot}35°$ C.
Total sugars in inverted solution $= 10{\cdot}3$ per cent.

$$\frac{13{\cdot}34\times 100}{87{\cdot}9+(0{\cdot}06\times 10{\cdot}3)-0{\cdot}3(18{\cdot}35-20)} = 14{\cdot}99 \text{ per cent. of sucrose.}$$

(iv) 20 *per cent. of sucrose in milk filtrate.*
Change on inversion at $19{\cdot}8°$ C. $= 17{\cdot}74°$.
Total sugars in inverted solution $= 13{\cdot}1$ per cent.

$$\frac{17{\cdot}74\times 100}{87{\cdot}9+(0{\cdot}06\times 13{\cdot}1)-0{\cdot}3(19{\cdot}8-20)} = 19{\cdot}99 \text{ per cent. of sucrose.}$$

The divisor for milk and sucrose filtrates, prepared as above with citric and phosphotungstic acids, is therefore

$$87{\cdot}9+0{\cdot}06c-0{\cdot}3(t-20).$$

5. *Total solids (water) determination in milk and sucrose filtrates.*—This filtrate is distinctly acid, and it is to be expected therefore that, on evaporation to dryness at 100° C., inversion of sucrose will take place, with consequent fixation of a part of the water present, and that the water, as determined by loss on drying, will be too low. This would have the effect of making the percentage of sucrose found too high. The usual practice in determining total solids in acid sucrose solutions is to add a slight excess of ammonia before evaporating, and to correct the result for the ammonia which enters into combination with the acid present. When this was done to milk filtrates containing sucrose and lactose there was always slight browning of the residue, indicating decomposition. Even when the exact amount of ammonia was added for neutralisation to brom-thymol blue, slight browning occurred, and it was found difficult to arrive at a constant weight of residue. On the other hand, when neutralisation was omitted and the sucrose and milk filtrate evaporated direct on sand, only a relatively small part of the sucrose was inverted. When weighed amounts of sucrose were added to milk filtrates, the total solids of which had previously been determined, the increase in weight of the residue was only very slightly greater than the weight of sucrose added. Moreover, the total solids thus obtained showed no visible signs of decomposition. It would seem that the small amounts of citric and phosphotungstic acids present are not able to effect a notable inversion of sucrose under the conditions of the total solids determination. This is shown by the following results, in which 2 grms. of milk filtrate

were evaporated on sand, with and without the addition of 0·3 grm. of sucrose. Two grms. were taken instead of 5 grms., owing to the fact that the nickel dishes used for this experiment were smaller than those recommended by the Committee for the total solids of condensed milk.

Water content of 2 grms. of milk filtrate:

	A. Without sucrose. Grm.	B. With sucrose. Grm.	Difference from mean of A. Grm.
	1·8703	1·8684	−0·0013
	1·8692	1·8681	−0·0016
Mean	1·8697		

If complete inversion of the sucrose had taken place, the difference in water content found would have been −0·0150 grm. It appears, therefore, that not more than one-tenth of the sucrose present is inverted on evaporation of the acid filtrate. The effect of this on the water determination is less than 1 in 1000.

ILLUSTRATIVE EXAMPLE.—The following is an actual determination, showing the calculations involved.

	Grm.
Weight of milk taken	309·2
,, ,, sucrose added	48·0
	357·2

Therefore percentage of sucrose in the mixture = 13·44 per cent.

Total solids (water) determination on 5 grms. of the milk and sucrose mixture gave 76·28 per cent. of water.

Weight of 50 c.c. of filtrate taken for polarisation =54·34 grms.
Water determination on 5·4202 grms. of the filtrate gave 4·3381 grms. of water.
Therefore 54·34 grms. of filtrate contain 43·49 grms. of water.

Polarimetry.

Direct reading in 200 mm. tube	+12·85° at 18·1° C.
Invert ,, ...	− 0·86° ,, ,,
Change on inversion ..	13·71°

Direct rotation due to sucrose (approx.)

$$=13{\cdot}71 \times \frac{66{\cdot}5}{88} = 10{\cdot}36°.$$

Therefore rotation due to lactose =12·85−10·36=2·49°.

And approximate percentage of lactose in diluted filtrate

$$= \frac{2{\cdot}49}{52{\cdot}4} \times \frac{100}{2} = 2{\cdot}4 \text{ per cent.}$$

And approximate percentage of invert sugar in inverted and diluted filtrate

$$= \frac{13{\cdot}71}{88} \times \frac{100}{2} \times 1{\cdot}05 = 8{\cdot}2 \text{ per cent.}$$

Therefore concentration (c) of total sugars in inverted and diluted filtrate

$$= 8{\cdot}2 + 2{\cdot}4 = 10{\cdot}6 \text{ per cent.}$$

We have therefore:

Percentage of sucrose in the original mixture of milk and sucrose

$$= \frac{13{\cdot}71}{87{\cdot}9 + (0{\cdot}06 \times 10{\cdot}6) - 0{\cdot}3(18{\cdot}1 - 20)} \times \frac{100}{2} \times \frac{76{\cdot}28}{43{\cdot}49}.$$

$$= 13{\cdot}50 \text{ per cent.}$$

Theory $= 13{\cdot}44$ per cent.

It is of interest to calculate the relative effect on the final result of slight errors in the conduct of the analysis. An error of $\pm 0{\cdot}1$ per cent. in the final result, *i.e.* between 39·9 and 40·1 for a condensed milk containing 40 per cent. of sucrose, may be caused by any one of the following errors in working:

$\pm$ 0·03° in polarimetric reading.
$\pm$ 4 per cent. in calculating the concentration of total sugars.
$\pm$ 0·8° C. in reading the temperature of polarisation.
$\pm$ 0·01 grm. in the determination of water in the filtrate (assuming 4 to 5 grms. to be taken).

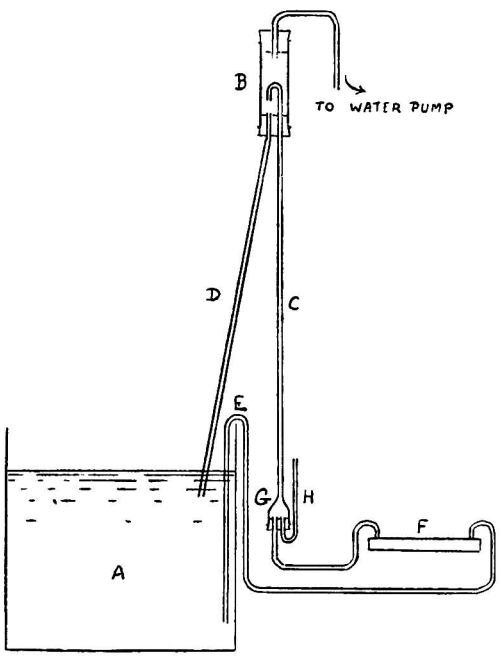
It is clear, therefore, that great accuracy is essential in the polarimetric readings, and, to a less extent, in the reading of the temperature of polarisation, but that for most purposes an average figure may be taken for sugar concentration. In the water determination on the filtrate the allowable error is also considerable.

THE RATIO CORRECTION.—In the course of this work certain points arose as to the admissibility of taking the sucrose and water ratio as a means of obviating the volume correction for proteins and fats. It is possible that the proteins as they exist in milk are to some extent hydrated, or contain adsorbed water. This water might be given off during a total solids determination, but, on treatment of the milk with phosphotungstic acid, it might remain associated with the proteins and not pass through to the filtrate. This would tend to increase the factor x in the formula for sucrose percentage, without a corresponding increase in y, and lead to high results.

A further point is the existence in phosphotungstic acid of water of crystallisation. The acid used lost 10·5 per cent. of its weight on heating at 100° C. This is probably due in great part to water of crystallisation, but at the same time the

phosphotungstic acid is altered in character, and becomes to some extent insoluble. For this reason it was considered better to use the crystalline acid, especially as any increase in the water content of the filtrate due to this water of crystallisation will raise the term y in the formula, and thus will tend to compensate for any error caused by water of hydration or adsorption in the protein. To ascertain the corrections necessary for these two possible sources of error would be a difficult matter, and it is doubtful whether the accuracy of the final result would be increased sufficiently to justify the additional complication in the analysis.

A METHOD OF MAINTAINING CONSTANT TEMPERATURE IN A POLARIMETER.—A is a large water-vessel the size of which is sufficient to ensure that the temperature of the water, when brought approximately to 20° C. does not alter appreciably during 2 or 3 hours. The vessel actually used in these experiments was a galvanised iron tank holding from 14 to 15 gallons of water, and insulated with felt. B is connected with an ordinary water pump. The height of the tube D is about 30 inches above the water level of the tank. On starting the water pump, water rises in both the vertical tubes C and D, the water in C being drawn from the tank by way of the siphon tube E and the polarimeter tube F. At G a rapid air current enters through the bent tube H, and the air bubbles rising in C carry water with them into the vessel B, from which the water flows back through D to the reservoir, and the air goes to the pump. The curved tube in B is designed to prevent splashing. The internal diameter of the tube C is about 6–7 mm. and of D about 10 mm. The point G must be below the level of the water in the tank. If the air current through H to G does not start on putting the filter pump into operation, it will start immediately on blowing with the mouth through a rubber tube attached to the open end of the tube H.



With this arrangement it has been found an easy matter to maintain a rapid circulation of water at a constant temperature through the polarimeter tube. The actual temperature in the polarimeter tube is usually a fraction of a degree lower than that of the reservoir, owing to slight cooling during circulation.

Much of the analytical work in this paper has been carried out by my assistant, Mr. W. A. Godby.

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DISCUSSION.

THE PRESIDENT said that the Society was greatly indebted to Dr. Monier-Williams for his valuable paper, which had such a direct bearing upon the pressing question of the analysis of condensed milk. The author's way of getting over the difficulty of the volume occupied by the precipitate necessarily produced by any method of clarification was ingenious and highly promising. This question of the correction for the volume of the precipitate had been troubling the Milk-Products Sub-Committee for a long time. There seemed to be no doubt that frequently the concentration of sucrose in the clarified serum was different from that which would be produced if the ordinary theoretical correction for volume of precipitate were applied. This might be due to a variety of causes. The author's results showed that, at any rate under the conditions of precipitation employed, there was only a very slight, if any, increase in the sucrose to water ratio. He did not think that the author need apologise for introducing an empirical value into the specific rotation for sucrose in solution in milk. Specific rotations were all more or less affected by conditions, and to that extent were always of an empirical nature.

Dr. H. E. COX observed that the applicability of this method or any similar one to condensed milk could not satisfactorily be determined without a test of at least 12 months' duration, working on the product of the same herds and factory. His experience was that a method gave good results for several months, then at certain seasons of the year gave divergent results as compared with others applied to the same product. This pointed to the possibility of there being an unknown variation in the sugars at some periods, possibly influenced by health or diet. A fundamental problem required to be elucidated: what was milk-sugar? There was indirect evidence that it was not always the same and not necessarily the chemical product, lactose, and nothing else. Until we knew just what sugars had to be dealt with it was hardly to be expected that the difficulties of determination would be completely overcome. The determination of lactose in condensed skimmed milk proved more troublesome than in full cream condensed milks.

Captain J. GOLDING laid stress upon the point that in investigations of this kind milk fresh from the cow should be used, rather than town milk which might be derived from unknown sources. He asked for information as to the way in which the author had allocated the errors in the method.

Mr. C. M. HINTON said that he followed previous speakers in welcoming the new way in which Dr. Monier-Williams had attacked the problem of the volume of precipitate, but he thought it perhaps a little unfortunate that the neutral polarisation process had been brought in. It was not shown that this process had sufficient advantages over the ordinary acid process to compensate for the extra manipulation; in fact, there were even some disadvantages, which had led him to abandon the neutral process in the case of milk products. With regard to the summary of errors which Dr. Monier-Williams had given, was it to be taken that all the four limits of working mentioned had to be exceeded before an error

of $\pm 0{\cdot}1$ per cent. arose, or would each one of them, if exceeded, result in an error of that magnitude?

Mr. E. T. BREWIS asked if there was any evidence for or against sugar being adsorbed on the surface of the precipitate.

Mr. FERGUSON said that the method developed by Dr. Monier-Williams would probably be applicable to sweetened condensed milk, which in dilute solution, as it was not subjected to any drastic heat treatment during manufacture, might be comparable with the milk and sucrose solutions used in testing the method. Inversion factors given in other methods were based on experiments with unsweetened condensed milk, or on comparison with gravimetric results, and were not necessarily accurate when applied to sweetened condensed milk.

Dr. MONIER-WILLIAMS, in reply, said that he had not yet applied this method to the actual analysis of condensed milk, chiefly owing to the fact that he knew of no other accurate method with which to compare the results obtained. He agreed that there might conceivably be optically active bodies other than sucrose and lactose in sweetened condensed milk, and that a method which was satisfactory for sucrose in fresh milk was not necessarily so for condensed milk at all seasons of the year. It was precisely these considerations which had led him to adopt the "neutral" method, in preference to the more usual "acid" method. In the former both direct and invert polarisations were carried out under practically identical conditions of acidity, concentration, and salt content, and the only variable was the rotation of the sucrose before and after inversion. Whatever the nature of the optically active constituents of condensed milk, other than sucrose, their effect should be the same in both measurements, provided that their optical activity was not permanently affected by the actual operation of sucrose inversion. In the case of fresh milk the rotation of the optically active constituents present was quite unaffected by the inversion process with subsequent neutralisation. It was highly probable that the addition of 0·2 to the divisor, which was found necessary with fresh milk, would also be applicable to condensed milk, since it was mainly due to the soluble salts present, and to the acidity caused by the slight excess of precipitant used. It did not appear to be very sensitive to slight changes in salt content or acidity. There was no evidence of any adsorption of sucrose by the precipitate. If this were the case the ratio of sucrose to water in the filtrate, and hence the final result, would be too low. The limits of error given were those which, taken singly, would each account for an error of $\pm 0{\cdot}1$ per cent. in the final result.

The Analysis of Starch Sugar Degradation Products by Selective Fermentation.

By THOMAS McLACHLAN, F.I.C.

(*Read at the Meeting, October* 3, 1928.)

In order to obtain efficient control over the manufacture of products such as malt extract or glucose, it is essential that a fairly approximate method of analysis should be available.

The carbohydrates supposed by various authors to be present in commercial glucose and malt extract are dextrose, laevulose, sucrose, maltose, isomaltose, and various dextrins and maltodextrins, together with pentoses and traces of other sugars. These are usually reported as dextrose, maltose and dextrin or simply as maltose and dextrin.

Examination of Previous Methods.—The method of examination commonly in use is to determine the copper reducing power and the optical rotation of a 10 per cent. solution of the extract before and after fermentation with brewer's yeast. The reduction after fermentation is regarded as due to maltose present as malto-dextrin and is allowed for, and the optical rotation after fermentation, thus corrected, is presumed to be due to dextrin. By calculating from the remaining optical rotation and the total reducing power, the amount of maltose and dextrose is obtained. The method is not satisfactory and does not always give the results which are to be expected. All dextrins obtained by any method show a quite appreciable copper reducing power.

The method given in the *Chemists' Year Book*, in which fresh malt extract is used to hydrolyse malto-dextrin, was tried and found unsatisfactory.

Ling and Davis, and Ling and Rendle precipitate dextrose as the glucosazone, on the assumption that 0·1 grm. of dextrose yields 0·0731 grm. of glucosazone. I was unable to obtain a constant factor, even when attempting to adhere strictly to their method. Employing a highly purified dextrose, one worker obtained 0·087 grm. and another usually from 0·055–0·071 grm. of osazone.

According to the literature alcohol should precipitate dextrin and malto-dextrins, leaving dextrose and free maltose in solution. Various strengths of alcohol—70, 75, 80, and 85 per cent. by volume—were employed to give 5 and 10 per cent. solutions of extract. All the precipitates obtained by any of these processes contained dextrose, and even after reprecipitation glucosazone could be readily obtained from the precipitate, while the solution evaporated down and fermented, contained much dextrinous matter.

Bourquelot and his co-workers suggested methylating dextrose in the presence of emulsin in 70 per cent. methyl alcohol. The emulsin prepared by me may not have been very active, but only 25 per cent. of pure dextrose was combined at the end of a month instead of 80 per cent. This method could not be used therefore, for mixtures by workers unskilled in its technique.

A paper by E. H. Eitel led to the hope that it might be possible to ferment out various sugars by bacteria. *B. Shiga* and *B. paratyphosus A.* were used to ferment dextrose, but the fermentation did not proceed very far and then stopped.

ANALYSIS BY THE YEAST METHOD.—It was decided, therefore, to return to the use of yeasts, and the work of Davis and Daish was investigated. These authors employ *Saccharomyces Marxianus* or *S. exiguus* to ferment dextrose and to leave maltose unattacked. These yeasts (*S. Marxianus* and *S. exiguus*) were tried, but it was found that, in the presence of certain other sugars, notably lactose, *S. Marxianus* fermented a varying quantity of sugar, so that for practical use it was advisable to use *S. exiguus* only. At first ordinary brewer's yeast, from which a pure culture was isolated, was employed to ferment maltose, but, after the publication of the method of Nanji and Beaseley for the analysis of mixtures of starch sugars, *S. Frohberg* and *S. Saaz* were tried. The author's specimens of *S. Frohberg* and *S. Saaz* were obtained from the National Collection of Type Cultures. There still appears to be great confusion as to the various types of yeasts, those which the author has obtained both appear to belong to the top fermentation type and give different results from those obtained by Nanji and Beaseley, inasmuch as the Saaz yeast invariably ferments more carbohydrate than the Frohberg yeast. The differences in these yeasts was first pointed out by Lindner.

It has not been found practicable or necessary to follow the full technique recommended by Davis and Daish of clarifying the solution with lead subacetate before fermentation; moreover, the nitrogen bodies present in the malt extract are useful for the growth of the yeast, and it is necessary to add yeast water to assist the fermentation with glucose alone.

In order to obtain a more vigorous yeast growth I adopted the course of twice sub-culturing the yeasts for 48 hours on malt agar before use instead of using an old culture. By this means fermentation is always complete in three weeks and usually in a fortnight. Complete fermentation may also be hastened by rotating the tubes on the fourth or fifth day after inoculation, in order to introduce a fresh air supply and to distribute the yeast thoroughly throughout the tube.

During preliminary work on pure sugars dissolved in yeast water, it was found that the copper reducing power of the solutions never became negligible, thus confirming the statement of Balls and Brown, that during the fermentation of sugars, a small quantity of unassimilable reducing substance is formed in the solution. The amount of copper reducing power left in the solution is about 0·5 per cent. of the original reducing power, and, as the method of analysis about to be suggested is only approximate, it has been ignored.

After fermentation the contents of the tubes are washed into a beaker, evaporated to low bulk, and made up to volume. After filtration the specific gravities, optical rotations and copper-reducing powers are determined. It should be noted that the solutions, after fermentation, must be either filtered or centrifuged before attempting to carry out gravimetric copper determinations, otherwise difficulty is encountered in the filtration of the alkaline copper solution containing yeast. The copper reducing power is determined on that amount of the blank

solution estimated to give about 0·25 grm. of cupric oxide; with malt extracts and commercial glucose this is usually about 0·25 grm. of the original product. Factors for conversion of cupric oxide into the various sugars are taken from Elsdon's Tables. The factor 3·86 has been used to give the figure for the total solids.

The difference in the results obtained between the blank and the *S. exiguus* fermentation is due to dextrose and laevulose, that between *S. exiguus* and *S. Frohberg* to maltose; that obtained between *S. Frohberg* and *S. Saaz* is ascribed to "other fermentable sugars," and "dextrins" are left unfermented.

Optical Rotation of Dextrins.—It is the custom to employ the optical rotation as the method of determining the amount of dextrin in solution. The specific rotation of dextrin has previously been taken as +202° or +200°, but it is doubtful whether it is so great, as "dextrin" consists of a mixture containing:

	Specific rotation.	Cupric reducing power.
Malto-dextrin α	= 180°	R = 33 (Ling & Nanji)
Malto-dextrin β	= 173·5°	R = 43 ,,
Isomaltose	= 140°	R = 80 (Armstrong)
Stable dextrin compared with Maltose	= 185° = 138·3°	R = 14 (Ling & Nanji) R = 100.

Petit claims that the dextrins present after fermentation consist of a mixture of two dextrins, D′ and D, of which D′ is in a very large excess. He gives the optical rotation of D′ as 175°, and that of D as 184°. Although it has not been possible to investigate this matter fully, a figure of 181° has been obtained for residual dextrins, and 180° has therefore been employed in this work.

TEST EXPERIMENTS.—A sample of commercial glucose with high rotation (total solids 80·6 per cent.) has been examined on these lines, with the following results expressed on the total solids:

	By Specific gravity. Per Cent.	By copper reduction. Per Cent.	By alcohol. Per Cent.	By optical rotation. Per Cent.
Dextrose	23·2	23·7	24·9	25·8
Maltose	22·6	22·8	24·7	23·6
Other fermentable sugars	6·0	—	—	—
Dextrins	48·2	—	—	45·7

It is seen that, on the whole, the value obtained from the total solids figure is about as accurate as any of the others, while the method is decidedly less troublesome.

No alcohol determinations were made after the fermentation of the maltose.

The "other fermentable sugars" gave $[\alpha]_D = 155·5°$ and R = 77 (maltose = 100). The dextrins gave R = 26·7, a figure which is in fair agreement with that of the mixed dextrins and isomaltose of Ling and Nanji.

Three further samples of liquid glucose were examined, "other fermentable sugars" being included as dextrins.

		1. Per Cent.	2. Per Cent.	3. Per Cent.
Total solids		85·3	87·4	83·5
Results on total solids.	Dextrose	43·3	42·0	26·8
	Maltose	27·3	27·5	26·9
	Dextrins	25·6	27·7	26·3

ANALYSIS OF MALT EXTRACT.—*Dextrose and Laevulose.*—When attempts were made to correlate the various figures obtained after fermentation with *S. exiguus*, it was noticed that, although the loss in the copper reducing power corresponded very closely with the loss in gravity, the reduction in the optical rotation was much lower than was to be expected.

This can only be accounted for on the assumption that there is an appreciable amount of laevulose present in malt extract. As long ago as 1879 Brown and Heron showed that malt contains invertase, while T. O'Sullivan showed that it was present in the acrospire. Wright has recently shown that malt contains about 2·0 per cent. of laevulose and 4·0 to 4·5 per cent. of sucrose, equivalent to a total laevulose content on inversion of 4·25 per cent.

Evans reports an analysis of malt extract containing 2·67 per cent. of cane sugar. Not only does the author's experience negative the presence of cane sugar in malt extract, but Brown and Heron and O'Sullivan showed that there was sufficient invertase in malt to invert added cane sugar.

The results obtained from twenty extracts examined by the author are contained in the following table:

Malt extract.	Dextrose, by loss of gravity. Per Cent.	Dextrose, by loss in CuO. Per Cent.	Reduction in optical rotation.	Dextrose, by optical rotation. Per Cent.
1	24·2	26·3	4·5°	8·5
2	23·8	24·3	8·2°	15·6
3	23·6	24·9	9·2°	17·5
4	22·5	25·1	7·3°	13·9
5	22·1	23·1	4·8°	9·1
6	21·9	21·6	3·8°	7·2
7	21·6	20·2	6·7°	12·7
8	21·5	20·2	8·3°	15·8
9	21·2	21·0	8·3°	15·6
10	21·0	20·8	4·9°	9·3
11	20·8	21·2	6·3°	11·9
12	20·7	22·2	2·9°	5·5
13	19·8	20·6	7·8°	14·8
14	18·9	20·5	7·9°	15·0
15	18·1	17·7	7·5°	14·2
16	17·6	18·0	4·5°	8·5
17	16·7	18·4	7·5°	14·2
18	16·2	17·2	5·7°	10·8
19	15·1	17·2	2·9°	5·5
20	14·1	12·4	4·3°	8·2
Average	20·1	20·7	6·0°	11·7

From these figures it may be deduced that malt extract contains between 2 and 8 per cent. of laevulose. Considering the difficulty of obtaining accurate polarimetric readings with a coloured solution like malt extract, the probability is that the laevulose content is between 3 and 7 per cent., with an average of about 4 per cent. The figures agree fairly well with those given by Wright.

The loss in optical rotation caused by Frohberg yeast shows that this yeast ferments very little more than *S. exiguus*, other than maltose. Owing to the small losses in optical rotation and cupric reducing power and the consequent greater susceptibility to error, "other fermentable sugars" have only been determined by loss in gravity, and no attempts made to obtain any idea as to the average optical rotation or reducing power of these sugars. The dextrins have been determined from the residual optical rotation after fermentation with *S. Saaz*.

An analysis has been made of twelve commercial malt extracts.

			Percentage results on Total Solids.				
	Diastatic activity (Harrison & Gair).	Total solids. Per Cent.	Dextrose and laevulose.	Maltose.	Other fermentable sugars.	Dextrins.	Nitrogen.
1	nil	81·9	14·5	55·7	0·8	19·4	1·04
2	30	76·2	12·3	41·1	0·6	23·3	·73
3	50	71·8	10·1	48·1	4·5	23·8	·98
4	24	79·1	15·6	53·0	1·9	11·2	1·18
5	270	79·6	15·4	53·1	2·4	15·1	1·17
6	300	77·8	10·9	41·3	3·3	32·7	0·72
7	390	78·5	19·7	43·4	4·5	12·8	1·36
8	500	77·2	19·8	39·5	4·2	11·6	1·74
9	570	80·1	19·9	50·0	1·3	6·7	1·60
10	680	79·1	16·8	49·2	2·2	14·8	1·09
11	950	83·6	18·9	34·9	3·8	22·0	1·44
12	1060	73·1	25·5	32·7	4·0	13·4	1·72

Although it is not claimed that the above figures are absolutely accurate, they are thought to be within about 1 per cent. of the real figure expressed on the malt extract, and are believed to be more nearly correct than figures previously published for products such as malt extract.

ROUTINE METHOD OF ANALYSIS.—The following is suggested:—As a general routine method of examination eight tubes containing 50 c.c. each of a 10 per cent. solution of the substance under examination are sterilised in the steam steriliser for three successive days, with rapid heating on the first day to destroy diastase, if present. Two tubes are inoculated with *S. exiguus*, two with *S. Frohberg*, two with *S. Saaz*, and two kept as a blank. The whole set is incubated at 26° C. for 14 days. On the fourth or fifth day the tubes are rotated to distribute the yeasts and to introduce a fresh air supply. After fermentation, one tube from each yeast is each emptied into a separate 150 c.c. beaker, the tube being rinsed out

carefully and the whole evaporated to about 15 c.c. on a water bath or hot plate. The solutions are cooled, the volumes made up to 50 c.c. and the gravities are determined. The second tubes are kept for verification of results, if necessary.

Dextrose and Laevulose.—The difference in the total solids of the blank and the solution fermented by *S. exiguus* represents the amount of dextrose and laevulose. These can be determined approximately, if required, by means of the difference in the optical rotation, but the figure cannot be regarded as very accurate.

Maltose.—The difference in the total solids figures between *S. exiguus* and *S. Frohberg* represents maltose.

Other Fermentable Sugars.—The difference in the total solids figures between *S. Frohberg* and *S. Saaz* solutions gives other fermentable sugars.

Dextrins.—The optical rotation is determined and calculated for 100 per cent. product. Then

$$\text{dextrins} = \frac{[\alpha]_D \times 100}{180} \text{ per cent.}$$

It is suggested that these figures should always be calculated and returned on 100 per cent. of total solids.

SUMMARY.—1. Various methods for the determination of sugars in starch degradation products have been examined.

2. The method of selective fermentation by different yeasts has been found the most satisfactory.

3. Analyses are given of four samples of commercial glucose and twelve samples of commercial malt extracts.

The author's thanks are due to Mr. Norman Evers for his interest in this work, to Mr. J. M. Jones for his assistance, and to Messrs. Allen & Hanburys, in whose laboratories the work was carried out, for permission to publish the results.

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DISCUSSION.

The PRESIDENT asked whether there was any possibility of obtaining active enzymes from the micro-organisms mentioned, for use in place of the yeasts themselves. The time required for the fermentation would, he feared, in some circumstances be a disadvantage, but this biological method provided a solution where strictly chemical processes failed.

Mr. H. F. E. HULTON said that he had experienced the same anomalous fermentation results as the author when using the Saaz and Frohberg yeasts obtained from the Lister Institute.

Mr. R. L. COLLETT said that he knew that every possible precaution was taken at the Lister Institute to ensure the correctness of the various strains of bacteria and yeasts, but suggested that, when yeasts had been continually sub-cultured, they might no longer show the same fermentation properties. He asked the author whether his yeasts had shown the same properties at the end of a year.

Mr. T. H. POPE suggested that storage of the pure yeasts in 10 per cent. cane sugar solution might serve as a means of keeping the properties of the yeasts unchanged, and asked if the author had tested his method on mixtures of pure sugars, etc., made up to resemble malt extracts in composition.

Mr. F. E. DAY asked whether the author had attempted to remove the dextrose by means of a suitable species of azobacter. He had used a variety of this organism for the purpose some years ago, when investigating the composition of confectioners' glucose. Like the author, he had come to the conclusion that the specific rotatory power of non-reducing "dextrin" was about 180°.

Mr. MCLACHLAN, in reply, thought that it was impossible to dry the yeasts in order to utilise the enzymes, as many enzymes were destroyed during the process. If brewer's yeasts were dried with acetone the maltase was destroyed, and the invertase present could then be utilised to determine sucrose in a mixture of sugars containing dextrose, maltose, etc. He had kept some of his yeasts for about three years and all of them for over a year, and by always keeping young cultures and twice sub-culturing before use, as suggested in the paper, he had never found any variation in their fermentation powers. He had tried simple mixtures of sugars in yeast water and had obtained satisfactory results with them. He had not tried any other bacteria, as the first results were so disappointing, and he did not want to have too many, perhaps dangerous, strains in his laboratory.

Notes.

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

THE SULPHIDE STAIN METHOD FOR DETERMINING SMALL QUANTITIES OF "VOLATILE SULPHUR" IN SUGAR.

THE following modification of J. S. Mann's "sulphide stain" method (*cf.* Ogilvie, ANALYST, 1927, **52**, 92) has been found to be extremely sensitive. The apparatus, which is similar to that used in the Gutzeit test for arsenic, comprises a tall glass bottle of about 150 c.c. capacity, into which is fitted by means of a

waxed cork a tube (15 cm. by 12 mm.), having a constriction about one-third of the distance from the top, to receive a plug of cotton wool. This tube is also provided with a waxed cork through which passes a tube (15 cm. by 5 mm. bore) constricted 7 cm. from the top to retain the test slip in position.

The lead acetate test papers are prepared by soaking English filter-paper in a 25 per cent. solution of neutral lead acetate, drying them in air, and then cutting them into strips (6 cm. by 4 mm.); these strips are kept moist by placing them in a desiccator in which the usual dehydrating agent is replaced by wet pumice.

After each test the lower tube should be dried and a fresh plug of cotton wool inserted.

In making a test 25 grms. of zinc pellets (free from sulphur) are placed in the bottle, and washed with dilute hydrochloric acid, followed by air-free distilled water. The zinc is covered with 50 c.c. of air-free distilled water, and the sugar sample introduced. Fifty c.c. of hydrochloric acid (1:1) are added, and the connecting tubes at once placed in position. After a few seconds the bottle is shaken gently, and then allowed to stand for one hour, after which the test paper is removed, dipped in molten paraffin, and compared with standard stains. The sample taken should be of such a size that the stain falls within the scale of standards given below.

Preparation of the Standard Stains.—Saturate air-free distilled water with sulphur dioxide from a siphon; dilute this solution to a convenient strength with air-free distilled water, and determine the sulphur dioxide present by means of $N/20$ iodine solution.

From this prepare five solutions containing 0·0001, 0·0002, 0·0003, 0·0004, 0·0005 grm. of sulphur dioxide, respectively, and 10 grms. of pure sucrose per 100 c.c. Air-free distilled water must be used and every precaution taken to prevent any oxidation of the sulphur dioxide during manipulation.

Standard stains corresponding to 0·005, 0·010, 0·015, 0·020, 0·025 mgrm. of sulphur dioxide will be obtained when 5 c.c. of each of the above solutions are used in the apparatus.

Since the test is also applicable to the determination of traces of hydrogen sulphide, it is probably advisable to express the stains in terms of sulphur. Attempts were made to differentiate between the sulphur in the two forms, but no satisfactory method was evolved.

It was noticed that more intense standard stains were obtained when sulphur-free sugar was present than from plain sulphur dioxide solutions. Probably the sugar prevents displacement of sulphur dioxide by the hydrogen before reduction has occurred. When standard stains were prepared under these conditions with known amounts of hydrogen sulphide and sulphur dioxide, a comparison showed that one part of hydrogen sulphide was approximately equivalent colorimetrically to two parts of sulphur dioxide, thus indicating that complete reduction of the sulphur dioxide had occurred.

It is necessary to carry out a "blank" test, and it is obvious that the quantity of sugar required in the test will vary according to the amount of sulphur dioxide present. Thus when 1 part per million of sulphur dioxide is present 10 grms. of the sugar will be found convenient, whereas when there are 20 parts per million only 1 grm. is necessary; hence a preliminary trial should be carried out to ensure that the stain may fall within the prescribed range of standards.

J. M. Bryan.

Food Investigation Board of the Department of Scientific and Industrial Research and the Low Temperature Research Station, Cambridge.

Notes from the Reports of Public Analysts.

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

CITY AND COUNTY OF KINGSTON-UPON-HULL.

REPORT OF THE PUBLIC ANALYST AND BACTERIOLOGIST FOR THE YEAR 1927. DURING the year reviewed 1678 samples were examined, of which 1404 were received from inspectors under the Food and Drugs Acts. Of these, 865 were official (45 adulterated) and 539 were informal samples (15 adulterated).

STANDARDS FOR CHEESE.—Of 11 samples of cheese analysed, two were regarded as suspicious, and one was returned as adulterated. The two suspicious cheeses were Gorgonzola cheese showing low butyric acid content in the fat, but no definite adulterant could be detected. Four other Gorgonzola cheeses showed normal fat characters. The adulterated sample was a tinfoil-wrapped cheese containing only 12 per cent. of fat, a deficiency of at least 52 per cent. To avoid the necessity of fixing a standard for the fat content of different varieties of cheese, all producers and vendors of cheese might be required to decide and state to which class their product belongs—skimmed-milk or whole-milk cheese—when if it is skimmed or partly-skimmed milk cheese it will be so marked, and if not it must comply with the standard for fat which will be fixed for whole-milk cheeses. This standard should, it is suggested, be a minimum fat standard of 40–45 per cent., calculated on the dry matter of the cheese.

GLASS PARTICLES IN FOOD.—The publicity given to this subject (*cf.* ANALYST, 1925, **50**, 393) has undoubtedly resulted in a marked improvement in the type of glass container used for many foods, though some sauces and similar products still continue to be put up in bottles of the "burst-off" type, with dangerously sharp, uneven, jagged necks. Such a bottle was found to have been used for one of the three samples of sauces examined during the year under review. Besides these 3 samples of sauce, there were examined for glass particles:—Sugar, 18; jam, 12; marmalade, 2; bottled vegetables, 3; and all were free from separated glass. Of four samples of lemonade crystals and 4 bottled fruits, two samples and one sample respectively were found to contain particles of glass, in one sample (lemonade crystals) of appreciable size. Thus, of a total of 46 samples examined, 3 were found to contain separated glass particles.

CHEMICO-LEGAL CASES.—Investigations were made in three cases.

Alleged Illegal Operation.—A chemical examination of a number of medicines, pills, instruments, &c., was made in a case of *alleged manslaughter* (death after an alleged illegal operation). The pills contained ferrous iron compounds together with harmless vegetable powders, and in therapeutic action were similar to the well-known Blaud's pills. One medicine consisted, in the main, of a liquid extract of chillies, and possibly also contained ginger in addition, together with alcohol in the form of brandy. Another medicine examined showed, so far as the very limited quantity would admit of analysis, the constituents of *sal volatile.* The velvet upholstery of a chair submitted to examination was stained with blood, the nature of which was revealed by microscopical and micro-spectroscopical examination and by chemical means, while the fact that it was human blood was proved by serological tests (precipitin reaction).

Gas-poisoning Case.—This investigation involved the micro-spectroscopical analysis of a sample of blood in a suspected *gas-poisoning* case occurring at a works in the City. Carbonyl-haemoglobin was found in the blood, and the results obtained in the laboratory were proved chemically also to be due to carbon monoxide poisoning, and not to the similar characters sometimes noted in cases of pneumonia following influenza (due to nitroxy-haemoglobin).

A. R. TANKARD.

Legal Notes.

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

TABLE VINEGAR.

ON September 11th a shopkeeper was summoned at Atherstone, Warwickshire, for selling "table vinegar" containing 100 per cent. of artificial vinegar. The inspector stated that he asked for one pint of table vinegar, and was served from a barrel on which was a label with the words, "Finest table vinegar, pure, strong, wholesome." On analysis, the vinegar was found to be a vinegar substitute composed of acetic acid, water, and added colour. The defendant bought this vinegar at 9s. for six gallons, and it was worth less than half the price at which malt vinegar could be purchased.

Mr. W. T. Rigby, the County Analyst, said that, on analysis, he had found the sample to be wholly an artificial product. In the general acceptance of the trade there were two kinds of vinegar sold in this country—that derived from malt, barley, or cereals, and in which there must have been fermentation, and artificial vinegar prepared from acetic acid without fermentation. The words "finest table vinegar" suggested something superior to ordinary vinegar. Artificial vinegar was usually sold at 4s. for six gallons.

The solicitor for the defence said that the matter had been before Parliament, but that there was no legal standard, and the price did not enter into the matter. The inspector had asked for table vinegar, not for malt vinegar; hence no offence had been committed.

The Bench dismissed the summons, and at first refused but finally agreed to state a case.

SALE OF CARBOLIC ACID IN AN UNLABELLED BOTTLE.

ON September 12th, a Holloway oil and colourman was summoned at the North London Police Court for selling by retail a preparation of carbolic acid and homologues containing more than 3 per cent. of those substances in a bottle not bearing the special label required by the Poisons and Pharmacy Act, 1908. A woman had asked the defendant for carbolic acid to clean drains, but the quantity offered to her in a properly labelled bottle distinguishable by touch not being considered sufficient, she had been supplied with the poison in an ordinary pint wine bottle without the distinctive label required by the Act. Later, the same day, the woman, mistaking the bottle for one of home-made wine, drank some of its contents, and had to be taken to the hospital for treatment.

The defendant said that he had a letter from the wholesale firm to the effect that the fluid did not contain 3 per cent. of phenol and its homologues.

Mr. P. A. Self, F.I.C., who had analysed the sample, gave evidence that the amount of total phenols present was approximately 5·8 per cent., and that there were at least 3·5 per cent. of homologues of phenol. Some of the phenols were poisonous, others were not. It was difficult to separate the whole of the phenols, and it was possible that more than 3·5 per cent. of the homologues of phenol might be present.

The Magistrate (Mr. Snell) said, although they would all agree that the lady who, having bought the bottle of acid, drank from it the same day, almost deserved what she got, that did not alter the fact that the bottle was not properly labelled. He imposed a fine of £2 with 7s. costs.

WATER CARRIED IN MILK CART.

THE first case taken under the New Zealand regulation which prohibits the carrying of water in milk carts was tried at the Wanganui Court on July 28th. The milk vendor, who pleaded guilty, stated that the water was carried for general cleaning purposes and for use in case an inspector wanted to clean the sediment tester if he took a sample of the defendant's milk.

The Magistrate said that the regulation was to protect the public; otherwise the milk could be diluted after the milk had been sampled for testing. He would accept the explanation given and impose a nominal penalty of 10s. with 10s. costs.

Report of the Government Chemist upon the Work of the Government Laboratory.

FOR THE YEAR ENDING MARCH 31ST, 1928.*

THE Report deals with work done for the same Government Departments as before, including "Reserved Services" for the Government of Northern Ireland for dutiable goods and certain services for India, the Colonies Dominions Offices, Trinity House, and Australia. The total number of samples examined was 491,039, an increase of 21,397 over the previous year, made up by increases at Clement's Inn and Custom House branch, with a decrease of 18,572 at the Chemical stations, due to a reduction in wine samples. Samples of tea, sugar, sugar products, and tobacco exported on drawback have increased, as have those in connection with the Preservatives Regulations, due to dates of application of the Regulations to other foods having been reached during the year.

MINISTRY OF AGRICULTURE AND FISHERIES.—*Butter.*—Four of 851 samples contained over 16 per cent. water, but none of the 329 samples of margarine had an excess of water or butter fat.

Cheese.—Only five per cent. of the samples were prepared from whole-milk, 24 from milk with three-fourths of its fat, 13 from milk with half to three-quarters, and 18 from milk with a third to a half of its fat.

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

Cream.—The unpreserved cream samples contained 20 to 60 per cent. of fat; a sample described as "evaporated cream" was sterilised cream.

Condensed Milk.—Of 148 samples taken under the Public Health (Condensed Milk) Regulations, 32 were reported against, 5 owing to the milk being below the minimum standard, 8 because the equivalent of whole milk represented was overstated, and the remainder owing to labelling offences.

Sheep Dips.—Five of 83 samples were reported against.

Water and Pollution of Rivers.—Fifty-three samples of river water, muds and effluents were examined, and 5718 samples of sea water were tested for salinity.

Fertilisers and Feeding Stuffs Act.—One fertiliser consisted of a manure with very small quantities of fertilising ingredients sold without guarantee, and one was a shoddy deficient in nitrogen. The feeding stuffs included barley meals, 4 of which contained about 15 per cent. foreign material (rice-husks, tapioca root, maize and wheat offal); middlings, one sample with 5 per cent. of rice husk; Sussex ground oats containing 15 per cent. of tapioca root, 15 per cent. of barley and 30 per cent. of oat husks; maize germ meal; palm kernel cake deficient in oil; and linseed cake. There was no disagreement with the findings of the agricultural analysts concerned.

Miscellaneous Articles.—These comprised 73 samples of cattle foods, several fertilisers and feeding stuffs, samples of disinfectants, rat poison, herring for determination of arsenic, cheese, a sheep's jaw-bone for investigation of metallic sheen, etc. A report on commercial processes used in the preservation of eggs has been made, and an investigation into a suitable ink for marking eggs is in progress.

Merchandise Marks Act.—A sample of barley meal contained maize and bean, and one out of two samples of honey did not show evidence of being collected from the stated source.

AIR MINISTRY.—The samples examined numbered 1085.

CUSTOMS AND EXCISE.—*Beer.*—The total number of samples examined was 57,951, an increase of 1226 over the previous year. Of these, 219 were malt, corn, brewing sugar and exhausted grain, 240 yeast foods, etc., 7333 samples for checking assessment of duty, of which 263 were declared by the brewers at 1–5 degrees low in original gravity, and 4 more than 5 degrees; 1630 samples of spoilt beer, 7767 of beer as retailed for checking whether water had been added; 33 were samples of non-alcoholic beers, in 15 of which proof spirit exceeded 2 per cent., and 36 of herb beers, ginger beer, etc.; 20,934 samples of beer were examined for drawback, in which only 45 were over declared; 13,632 samples from the Irish Free State; 1982 samples of beer and brewing materials examined for arsenic, in 55 of which it was in slight excess, and 91 were miscellaneous samples.

Cocoa and Chocolate.—In connection with duty 11,257 samples from imported, and 3718 from exported foods were examined, including 3098 of imported chocolate confectionery examined for spirit.

Coffee and Chicory.—Of 2032 samples examined for drawback, 6 were incorrectly declared.

Dangerous Drugs Act.—Ten samples out of 35 contravened the provisions of the Act.

Safeguarding of Industries Act.—Samples were examined (11,574) as to whether the chemical was liable to tax, or, in the case of substances with trade names, for the nature of the ingredients.

Silk.—In connection with silk duties, 10,810 samples from imports, 9318 from exports and 787 from home factories were examined.

Spirits.—Wood and mineral naphtha (709) and pyridine (150) samples were examined, 3020 samples of exported spirits and 18,891 samples of exported spirituous preparations, of which 267 had their strength over-declared. Of 126,195 samples of imported spirits and spirituous preparations, many were sent for "obscuration" tests.

Sugar, Glucose and Saccharin.—Of sugar and articles containing sugar or other sweetening agent, 61,966 samples were examined for assessment of duty or drawback

Table Water Duty.—Unsweetened, but not sweetened, table waters are liable to Customs or Excise duty at 8d. per gallon, and imported waters are dutiable with regard to sugar or other sweetening agent. Of 42 mineral waters examined 9 were medicinal, and 33 liable to duty; none of the 12 cordials and non-alcoholic wines contained over 2 per cent. proof spirit.

Tea.—Of 41,149 samples, 277 contained foreign substances and 69 were unfit for human consumption, and these represented together 1478 packages. Large stocks of tea in bonded warehouses were re-examined on account of flood damage.

Tobacco.—Moisture (limited to 32 per cent.) was determined on 8876 samples for home consumption, and oil (4 per cent.) on 786 samples, and 43,856 samples for export were examined. The increase in the last mentioned (16,523 in 1927) was due to the large quantities of cigarettes now made from duty-paid leaf and thus entitled to drawback on export. Of stalks, 29783, and of offal snuff, shorts, and smalls 9137 samples were examined.

MINISTRY OF HEALTH.—*Preservative Regulations.*—The main provisions came into force on 1st January, 1927 (N. Ireland, 1st July), and the application to butter, ham, egg yolk on 1st July, and to butter, cream, and pearl barley on 1st January, 1928. Except for a few foods and beverages, no articles of food containing preservatives may be sold, nor may any colouring matter be added, or thickening substance to cream, and this applies to imported foods. Within the country the administration is as for the Food and Drugs Acts, and some imported materials are sampled by the Board of Customs and Excise. Where samples are already taken for fiscal purposes the same ones are used. During the year 1462 of imported dairy produce and 1671 samples of other foods were examined. The samples included fruit in pulped condition for the jam-making industry, and canned, drained and dried fruit; vegetables in brine, and vegetables canned and dried; sugar including glucose and molasses; honey; wine, beer and cider; grape and other fruit juices, syrups and cordials; cocoa, chocolate and sweetmeats; gelatine; liquid eggs; cereals, biscuits, breakfast and invalid foods; butter, cream, margarine; condensed and dried milk; custard powder and cornflour; colouring matters for use in confectionery; pearl barley and pickles. Seventy of these were reported as contravening the Regulations, including 44 samples containing sulphur dioxide, nine with benzoic acid, either contrary to or in excess of that allowed; 13 of tinned vegetables contained copper colouring matter, and one hydrogen peroxide; 3 samples of butter contained boron preservative. It may be noted that the percentage of butter samples containing boric acid two years ago was 40, one year ago 20, and in the four quarters of the present year 13, 7, 5, and 1. No sample of margarine contained boric acid during the year and no imported creams since 1st January.

HOME OFFICE.—Amongst other investigations one was made to distinguish smoking opium from raw opium or opium extract.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH.—Oranges the skins of which had been washed with boric acid were tested by a specially sensitive method, but in no case was there more than a trace of boric acid in the peeled fruit.

SALE OF FOOD AND DRUGS ACTS.—Of the 26 samples of food examined under the Acts, 19 were milks, 2 jams deficient in fruit, and one each of cream containing boric acid, cream containing annatto, gin with excess of water, dripping containing cotton seed oil, and candied peel containing excess of sulphur dioxide. There were three cases of disagreement with results put forward by the prosecution; in five cases information was insufficient to enable a statement of agreement or otherwise to be made; in the remaining case varying results were probably due to inefficient mixing of milk, and it is pointed out that exceptional care is necessary in sampling milk in the modern form of bottle. The three cases of disagreement were, milk, in an "appeal to the cow" case, which was alleged to show no deficiency of fat, but contained only 2·73 per cent.; milk, alleged to contain in each gallon eight grains of sediment mainly from farmyard débris, contained one-half of the alleged amount of sediment and not mostly from farmyard débris; and milk alleged to contain added water, which had non-fatty solids 8·51 per cent.

D. G. H.

Dominion of Canada.

REPORT OF THE DOMINION CHEMIST FOR THE YEAR ENDING MARCH 31, 1927.

IN his annual report Dr. Shutt states that the endeavour of the Department of Agriculture to help individual farmers by correspondence and by analysis has continued to meet with an appreciative response. This phase of the chemical division's activities is, of course, carried on in addition to the main work of investigating special problems in connection with Canadian agriculture.

The number of samples examined during the year was 4828, and included many sent in by farmers and agricultural representatives and those submitted by the Meat and Canned Foods Division (Dept. of Agriculture). As in the past, experiments with fertilisers have been carried on at several of the branch farms and stations, and the value of several new fertilisers which have recently appeared on the market has been investigated. Full details of this work are given in the report.

INSECTICIDES AND FUNGICIDES.—Chemical analysis and physical examination of the more commonly used insecticides and fungicides on the Canadian market and co-operative work with the Entomological Branch constitute the two chief phases of the division's activities in this field.

A chemical and physical examination of oils was made to determine whether there is any correlation between the constants of an oil and its effect upon insects or plant growth. The constants determined were viscosity, density, capillarity, flash point, fire point, sulphonation test, distillation range and reaction to litmus. It was found that the sulphonation test is the most important criterion for deciding as to the toxicity or non-toxicity of an oil.

Chemical assistance has been given towards the establishing of desirable "standards" to be used in connection with the new Act governing the sale of insecticides and fungicides.

SOLUBLE ARSENIC IN CALCIUM ARSENATE AND LIME SULPHUR SPRAYS.—A sample of calcium arsenate was received with the remark that it had caused severe injury to foliage when used with a lime and sulphur spray. The sample contained 2·06 per cent. of moisture, 40·29 per cent. of total arsenic oxide (As_2O_5), and 1·63 per cent. of water-soluble arsenic. When submitted to carbon dioxide aspiration in a 3–10–50 Bordeaux spray it liberated no soluble arsenic whatever, thus indicating that it was chemically stable and not liable to cause foliage injury. A consideration of this case, however, made it desirable to ascertain to what extent soluble arsenic is liberated when calcium arsenate is added to lime sulphur, with and without added lime. A spray solution was therefore prepared similar to the one stated to have caused the foliage injury in the orchard. The sample of lime sulphur contained 24·8 per cent. of total sulphur. After the concentrated spray materials were mixed and allowed to stand for 40 hours the following amount of water-soluble arsenic oxide were found:—In the spray (supernatant fluid), 0·69; in the sediment when lime was used, 0·49; in the sediment, without lime, 1·42 per cent. The diminution of water-soluble arsenic oxide caused by lime is only temporary, since atmospheric condition and the respiratory carbon dioxide from the living leaf surface will again set free soluble arsenic. Hence, if for any reason a tank of spray has stood for any length of time before use, it should be emptied and all sediment flushed out.

DERRIS ROOT.—This newly introduced insecticide is regarded as a contact and stomach poison. The sample analysed was a finely ground yellowish powder, which on analysis give the following results:—Moisture, 6·48; ethereal extract, 8·79; methoxyl content, 14·90*; alcoholic extract after extraction with ether, 14·25 per cent.†

The most important constituents of the root are a white crystalline substance, "tubatoxin" or "rotenon," and a series of resins called "derride" or "tubain." In addition, the roots contain mucilage, gums, tannin, and fatty substances. The poisonous constituents are solid, relatively non-volatile, and only slightly soluble in water. In the Tropics, and especially in the Malayan Peninsula, derris root is used as a fish poison, as well as an insecticide. The green roots are macerated and the milky suspension poured into the stream; the fish rapidly come to the surface and are captured while stupefied.

The pieces of root on arrival in Canada are quite dry, and for this reason the root should be ground to an impalpable powder, and special means taken to have it dispersed throughout the spray fluid; for maximum efficiency the use of organic solvents, *e.g.* wood spirit, is advisable.

Derris is quite poisonous to lower forms of life; in moderate doses it is not poisonous to man.

* The percentage of ethereal extract *per se* cannot be regarded as a measure of the toxicity of a sample, but, considered in conjunction with the methoxyl content, it helps towards a decision as to genuineness and strength.

† This gives a general indication of the non-toxic constituents having some value as emulsifying or wetting agents. The percentage here found was high, indicating that this sample possessed high emulsifying properties ; this was confirmed later by actual use of the root in spray preparations.

FLY AND MOTH PREPARATIONS.—Five preparations with specific names were submitted for examination, with the following results. The base of all of them, with the exception of "Larvex," was kerosene.

ANALYSIS OF FLY AND MOTH PREPARATIONS.

Preparation.	Flit.	Fly-tox	Sapho "Fly X."	Sapho-Liquid.	Larvex.
Sp. gr. at 19° C.	0·810	0·830	0·844	0·844	1·007
Flash point	60° C.	66° C.	67° C.	67° C.	—
Fire point	69° C.	78° C.	77° C.	78° C.	—
Relative volatility ..	5·5%	3·78%	5·6%	7·25%	31·98%
Residue at 100° C. ..	0·28%	0·31%	0·15%	0·81%	—
Methyl salicylate (by weight)	0·75	3·13	2·08	—	—
Phenol (carbolic acid) ..	—	—	—	1·68%	—
Sodium fluosicilicate ..	—	—	—	—	1·80%
Pyrethrum	—	present	—	—	—

ARSENIC IN APPLES.—Fifty-six samples representative of the products from sprayed orchards from the chief apple-exporting districts in the different provinces of the Dominion, were examined. One -third were entirely free from arsenic or contained only negligible quantities, and ninety-five per cent. of the samples contained amounts of less than 1/100 grain per lb.

TOMATO PRODUCTS.—The average, maximum and minimum percentages of total solids in 23 samples of tomato paste were 35·3, 46·2 and 19·6 respectively. Of 54 samples of tomato ketchup, pulps and sauces tested for coal tar colour and preservatives, 29 contained preservatives (benzoates or salicylates), 8 having amounts in excess of the maximum permitted. Twenty-three samples contained coal tar colour, Ponceau 3 R (S. & J. 56), which is permitted under the regulations. A small amount of a gummy substance was found in all the samples, but its quantity was not considered to be excessive (*cf.* ANALYST, 1928, 538).

FISH AND MEAT PASTES.—Fourteen of 93 imported fish pastes contained a coal tar colour (Rhodamine (S. & J. 505)). No preservatives were found. Forty-seven samples of imported meat paste were free from coal tar colour and preservatives. The average maximum and minimum amounts of cereal starch in 18 samples of fish paste were 2·7, 7·9 and nil, respectively, the corresponding figures for 10 samples of meat paste being 4·2, 6·9 and 1·2, respectively.

NITRITE IN BACON AND PICKLING SOLUTIONS.—The maximum amount of sodium nitrite allowed by the regulations is 200 parts per million. Thirty-nine samples of pork and bacon were examined, and 14 were found to contain nitrite in excess of the permitted quantity. Of 37 samples of pickling liquids examined, 7 contained more than 200 parts per million, one of these containing as much as 1820 parts per million.

Government of Palestine.

ANNUAL REPORT OF THE LABORATORY SECTION OF THE DEPARTMENT OF HEALTH FOR THE YEAR 1927.

THE Government Central Laboratories in Jerusalem constitute, as previously, the headquarters of the Section. At the ports of Haifa and Jaffa, however, Government also maintains branch laboratories which, in addition to meeting the usual

hospital and public health needs of these districts, comply with the requirements of the International Sanitary Convention and are specially equipped for cholera and plague examinations.

In order to cope with the work entailed by an ever-increasing number of medico- and chemico-legal examinations and by mass-production of vaccines, a second bacteriologist and an additional chemical laboratory technician were appointed towards the end of the year. The senior staff of the Central Laboratories now consists of the Officer-in-charge (the Assistant Director, Dept. of Health), the Government Analyst (Mr. Baker), one Assistant Analyst, and first and second bacteriologists.

BACTERIOLOGICAL SUB-SECTION.—During the year a record of 140,839 routine examinations were made in the bacteriological laboratories in Palestine. Of the 23,923 blood films examined for malaria, positive results were obtained in 4264 cases. The work also included 11,075 agglutination tests, and the preparation of specific anti-sera for the precipitin test, which was applied on 32 occasions.

A regulation in force since 1922 is to the effect that release of certain preparations from Customs may not be sanctioned until a report has been received upon a sample sent to the laboratories. This regulation refers to vaccines, sera, virus (rat killer) and all products of bacterial origin. 357 such examinations were carried out during the year.

Identification and Examination of Snails.—The endemicity of urinary schistosomiasis has resulted in a continued forwarding from all districts of snails for identification. In only two regions have infected snails been discovered, and these were mentioned in last year's report. The species of snail to which the dissemination of schistosomiasis in Palestine is attributed is *Isodora truncata*. During the year considerable attention has been given to an enquiry into the reason for the limitation of these snails to two areas. The hypothesis that distribution of schistosomiasis might be dependent on the hydrogen ion concentration of the soil and water, as limiting the distribution of the snail-hosts and affecting the liberated miracidia, led to over 200 examinations being made on waters from all over the country.

The regional reaction of snail-bearing areas proved to be within the range P_H 6·6 to P_H 8·4, but the results of the investigation pointed to P_H values being not the cause, but only one contributing cause of limitation of snail spread. *Isodora* development was found normally to take place between P_H 7 and P_H 7·4.

CHEMICAL SUB-SECTION.—The total number of samples examined was 5620, as compared with 5525 in 1926. Of these, 3807 were milk, of which 169 (4·4 per cent.) were the subject of prosecutions, compared with 3 per cent. in 1926.

As the result of regulations forbidding the use of lead cooling pipes in soda fountains (see ANALYST, 1927, **52**, 231; 1928, 97), tin piping has now been obtained by local merchants, and is in general use. Thirty-three samples of such piping were submitted for examination.

BUTTER.—Many varieties of butter substitutes are now on the market, many of them being composed of gamoose cream blended with vegetable fats. Although the quality is generally satisfactory, the labelling leaves much to be desired. A favourite label bears the picture of a cow and the words "Good fresh butter" in bold type, qualified by the words "artificial," "mixed" or "vegetable" in very small type. Under new legislation now in preparation it is intended to confine the use of the word "butter" to the genuine article only, as in English law.

LEGAL, JUDICIAL AND POLICE DEPARTMENTS.—Seven cases of suspected poisoning were investigated, and arsenic was found in one, about 0·25 grm. of

white arsenic being found adhering to the stomach walls. The other six cases gave negative results.

Investigations arising out of the Earthquake.—In connection with the death of three persons owing to the collapse of a hotel during the July earthquake, the question arose as to whether the materials used in the construction of the hotel were of satisfactory quality. Six samples of the broken concrete from the ruins, together with samples of cement, stones and sand produced by the builder as being similar to the material used, were submitted by the Coroner for analysis, with a request for a report upon the proportion of cement to stones and sand in the concrete.

Specimens of concrete were prepared in the laboratory from the materials supplied, and these, together with the raw materials and the concrete from the ruins were analysed for the content of soluble silica by the method of D. Florentin (ANALYST, 1926, **51**, 480). By this method it has been found that by determining the soluble silica in the cement and in the concrete it is possible to arrive at a close approximation to the proportion of cement to stones and sand used in making the concrete. In this instance the analytical findings confirmed the builder's declaration.

Following the earthquake there were many rumours of volcanic manifestations, especially in the Jericho Valley, but the only material submitted for examination in this connection, and which was said to have come from an "earthquake crack," proved to be a mixture of sand and gypsum.

Even in Jerusalem, there were persistent reports that smoke had been seen coming out of the ground in one quarter of the old city and the Analyst was finally asked to investigate and examine the "sulphurous smoke." It was found that a greyish white smoke was, in fact, issuing from the drains in many of the houses in one street. It was noted that it issued with a rapid pulsating motion and that it had an "oily" smell. On these clues being followed up, it was traced to an oil engine in a neighbouring workshop. The exhaust of the engine had been connected directly with the public sewer, which is part of an old drainage system, having no traps between the sewer and the house connections.

Parliamentary Notes.

FOOD AND DRUGS (ADULTERATION) ACT, 1928.

THIS Act [18 & 19, Geo. 5] [Ch. 31] is dated August 3, 1928, and is described as "An Act to Consolidate the Sale of Food and Drugs Acts." It includes no new regulations, but consolidates those contained in previous enactments. Its sections are arranged as follows:

PART I. GENERAL PROVISIONS.

Sec.

1. Restrictions on mixing food and drugs with other ingredients.
2. Prohibition against sale of articles of food and drugs not of the nature, substance or quality demanded.
3. Provision as to sale of compounds.
4. Protection from liability where article properly labelled.
5. Offences in relation to abstraction from articles of food or parts thereof.

PART II. PROVISIONS WITH RESPECT TO SPECIAL ARTICLES.

6. Conditions to be observed in dealings in margarine, margarine-cheese and milk-blended butter.
7. Power to make regulations as to constituents of milk, butter, cheese, etc.

8. Registration of factories and wholesale premises.
9. Registration of consignments.
10. Prohibition of adulterants in butter factories.
11. Limit of moisture in butter, etc.
12. Restrictions on the importation of agricultural and other produce.

PART III. ADMINISTRATION.

13. Food and Drugs Authorities.
14. Duty of authorities to enforce Act.
15. Appointment of analysts.
16. Powers of sampling.
17. Right to have samples analysed.
18. Division of and dealings with samples.
19. Power of Ministers to have articles analysed.
20. Powers of Commissioners of Customs and Excise to have imported articles sampled.
21. Special provisions as to sampling of milk.
22. Inspection of factories.
23. Approval of names for use in connection with margarine and milk-blended butter.
24. Obstruction of officers in discharge of duties.
25. Quarterly reports by analysts.
26. Expenses of Food and Drugs Authorities.

PART IV. LEGAL PROCEEDINGS.

27. Prosecutions and penalties for offences.
28. Service and evidence of certificates of analysis.
29. Conditions under which warranty may be pleaded as defence.
30. False warranties and certificates.
31. Power of court to require analysis by Government chemist.
32. Application of fines.
33. Saving for contracts.

PART V. MISCELLANEOUS.

34. Definitions.
35. Application to Scotland.
36. Application to Northern Ireland.
37. Repeals.
38. Short title and commencement.

Schedules.

The first schedule gives the form of certificate of a Public Analyst; the second gives special provisions as to milk; the third gives rules for determining whether offences are second or subsequent offences; and the fourth schedule gives the following list of enactments repealed by the Act:

ENACTMENTS REPEALED.

Session and Chapter.	*Short Title.*	*Extent of Repeal.*
38 & 39 Vict. c. 63.	The Sale of Food and Drugs Act, 1875.	The whole Act except Secs. 30, 31, and 36.
42 & 43 Vict. c. 30.	The Sale of Food and Drugs Act Amendment Act, 1879.	The whole Act.
50 & 51 Vict. c. 29.	The Margarine Act, 1887.	The whole Act.
55 & 56 Vict. c. 55.	The Burgh Police (Scotland) Act, 1892.	In Sec. 432 the words "under the Sale of Food and Drugs Act, 1875, and also."
62 & 63 Vict. c. 51.	The Sale of Food and Drugs Act, 1899.	The whole Act.
7 Edw. 7, c. 21.	The Butter and Margarine Act, 1907.	The whole Act.
4 & 5 Geo. 5, c. 46.	The Milk and Dairies (Scotland) Act, 1914.	Sec. 27.
5 & 6 Geo. 5, c. 66.	The Milk and Dairies (Consolidation) Act, 1915.	Sec. 9 and the third Schedule.
11 & 12 Geo. 5, c. 32.	The Finance Act, 1921.	Sec. 23.
11 & 12 Geo. 5, c. 42.	The Licensing Act, 1921.	Sec. 10.
17 & 18 Geo. 5, c. 5.	The Sale of Food and Drugs Act, 1927.	The whole Act.

ABSTRACTS OF PAPERS PUBLISHED IN OTHER JOURNALS.

Food and Drugs Analysis.

Valuation of Army Biscuits from Chemical Analysis. J. Straub and J. P. Peper. (*Pharm. Weekblad*, 1928, **38**, 765–776.)—The biscuits, which are prepared from wheat flour, cane sugar and lard, weigh on an average 62·7 grms. and contain 11·18 per cent. of water, 9·67 per cent. of cane sugar, and 3·90 per cent. of fat after a normal baking period of 28 minutes. There is normally a loss of about 10 per cent. of sugar and 1·7 per cent. of fat in the process, but after longer baking periods the loss is greater. The sugar and fat were determined by the Dutch official methods, but as a result of comparative experiments with different methods, the moisture was determined on 5 to 10 grms. of the powdered material, which was placed in a steam-heated vertical cylinder and the moisture removed in a stream of air dried over concentrated sulphuric acid. J. G.

Detection of Artificial Colouring Matters in Fruit Juices and Similar Products. A. De Kroes and A. Reclaire. (*Chem. Weekblad*, 1928, **25**, 525–528; *cf. id.*, 1927, **24**, 130.)—The tests for coal-tar colours have been applied to the coloured solutions obtained by the extraction of a number of fruits and vegetables with 10 per cent. alcohol. Arata's wool test gave more or less coloured threads, no further colour being removed by a second immersion, and warm solutions of potassium bisulphate (10 per cent.), or ammonia (1 per cent.) had usually little effect on the dyed wool. Van Spaeth's test, in which the colour is extracted with amyl alcohol before and after the addition of sulphuric acid or ammonia, gave characteristic results, the colour in the alcohol layer usually being dispersed after treatment with ammonia. Yellow or almost colourless filtrates were usually obtained after treatment with basic lead acetate, or with mercuric oxide or chloride (Cazeneuve's test), and no colour could be extracted from them with amyl alcohol. J. G.

Use of Buffers in the Determination of Amaranth, Ponceau 3R, and Orange I by means of Titanium Trichloride. O. L. Evenson and D. T. McGutchen. (*Ind. Eng. Chem.*, 1928, **20**, 860–862.)—The colour content of amaranth may be determined accurately by titration with titanium trichloride solution in the presence of sodium citrate, sodium hydrogen carbonate or potassium antimony tartrate. From 5 to 10 grms. of the buffer salt are dissolved in boiling water, a solution containing about 0·3 grm. of the dye is added, the volume adjusted to 100 c.c., and the boiling solution is titrated with standardised titanium trichloride solution in an atmosphere of carbon dioxide. Ponceau 3R may be titrated in a similar way in the presence of sodium citrate or sodium hydrogen carbonate, and Orange I in the presence of sodium citrate, sodium hydrogen carbonate, or the tartrates, except potassium antimony tartrate. W. P. S.

Glycerides of Fats and Oils. XII. Glycerides of Lauric and Myristic Acids. A. Bömer and K. Ebach. (*Z. Unters. Lebensm.*, 1928, **55**, 501–528.)—As the result of a series of fractional distillations of oils in a cathode vacuum, followed by determinations of analytical numbers on the distillates and on the constituents separated from them by a large number of fractional crystallisations from acetone, the following facts were established :—*Palm kernel oil* contains a relatively high proportion of glycerides of oleic acid, which, however, decompose as the temperature rises during distillation. Myristodilaurin and laurodimyristin were also obtained (*cf.* Bömer and Schneider, *id.*, 1924, **47**, 89). *Coconut oil* yielded volatile glycerides, without appreciable decomposition, on fractional distillation either alone or in the presence of about 50 per cent. of natural or hardened sesame oil (*cf.* Bömer and Baumann, *id.*, 1920, **40**, 151). Mixtures containing 40 or 60 per cent. of the latter gave distillates which showed a stronger reaction for furfural than the distillation residue. *Bay oil* was found to contain about 30 per cent. of trilaurin (m.pt. 45·6° C., corr.) in the solid portion, but, with the exception of myristin, no sparingly soluble glyceride was detected. *Mace oil* contained 40 per cent. of sparingly soluble trimyristin (m.pt. 56·2° C., corr.) and 6 per cent. of free stearic acid. The synthesis of α-lauro-$\alpha\beta$-dimyristin, $C_3H_5(C_{12}H_{23}O_2)$, $(C_{14}H_{27}O_2)_2$, m.pt. 43·3° C. from α-monolaurin, produced by hydrolysis of mono-lauro-acetone glycerol is described, and α-myristo-$\alpha\beta$-dilaurin, $C_3H_5(C_{14}H_{27}O_2)$, $(C_{12}H_{23}O_2)_2$, with m.pt. 38·0° C., was also prepared by an analogous series of reactions. The analytical numbers were in agreement with the calculated values and with those obtained for the natural glycerides. J. G.

Lauric Acid Content of Coconut Oil and Palm Kernel Oil as a Means of Detecting these Fats in Nutrient Fat Mixtures. J. Grossfeld. (*Z. Unters. Lebensm.*, 1928, **55**, 529–553.)—The amount of lauric acid, the chief constituent of coconut and palm kernel fats, is an indication of the presence and amount of these fats in fatty mixtures. Attempts to separate the lauric acid from the other fatty acids, notably by the precipitation of a solution of the potassium salts of the fatty acids by lithium chloride solution, were not successful, the reaction being influenced by the amount of lithium in excess, and in the case of butter fat by the presence of a high proportion of lithium oleate. It is shown how the mean molecular weight (M) of the fatty acids present in coconut oil, palm kernel oil or butter fat, and precipitable by magnesium sulphate solution, may be obtained from the saponification value (V) of the triglyceride by means of the formula $M = 56110/V - 12{\cdot}675$, and a table is given showing the values of M for $V = 170$ to 269. Differentiation of this equation gives $dM/dV = -(236{\cdot}9/V)^2$, in which the minus sign indicates that an increase in V corresponds with a decrease in M. For the precipitation of the fatty acids, 20 c.c. of a 1·5 per cent. solution of magnesium sulphate were used for 0·5 grm. of saponified fat, the salts being filtered on a tared Gooch crucible, weighed when dry, ignited, and again weighed in order to obtain the weight of fatty acid anhydrides. Determinations were made of V, the butyric acid value (B) and the caprylic acid value (C) for 10 samples

of butter, and the corresponding values of M were found to vary from 256·5 to 264·7 (mean 260·0), and to correspond with the value for the non-volatile fatty acids, found by Juckenack and Pasternack (*id.*, 1904, **7**, 204). The number of c.c. of 0·1 N lauric acid in 5 grms. of fat (lauric acid value, L) may be determined approximately from the formula $L=3{\cdot}3\ (V-B-1{\cdot}2\ C-V')$ for coconut and palm kernel and butter fats, B being omitted if butter fat is absent. V' is the saponification value of the pure fat, which if it is not known may usually be put equal to 197 (*cf.* Crowther and Hynd, *Biochem. J.*, 1917, **11**, 139). Thence L was found to vary from 111 to 138 (mean 126) for 22 samples of coconut and palm kernel fat, and from 5 to 18 (mean 11) for 10 samples of butter fat. J. G.

Determination of Sugars from the Oxygen Content of the Cupric Oxide. M. D. Hadjieff. (*Z. Unters. Lebensm.*, 1928, **55**, 613–614.)—In the Meissl-Allihn method for the determination of sugars, 25 c.c. of sugar solution (concentration less than 1 per cent.) are pipetted into a hot mixture of 60 c.c. of water and 30 c.c. of Fehling's solution, and after 2 minutes 100 c.c. of cold boiled water are added. The author then prefers to filter and wash the precipitated cuprous oxide in an asbestos-packed Gooch crucible, to dry it at 120–130° C., and then to heat it in a current of dry air. The cupric oxide produced is weighed, heated in a stream of dry hydrogen, and reduced to copper, which is also weighed. The difference in weights gives the oxygen content of the cupric oxide, from which the factor 3·9731 is used to obtain the copper number, and thence the sugar content from the Meissl-Allihn tables. J. G.

New Acidimetric Method for the Determination of Glucose by Means of Fehling's Solution. M. D. Hadjieff. (*Z. Unters. Lebensm.*, 1928, **55**, 615–618.)—The cuprous oxide is precipitated by the usual Meissl-Allihn method (*cf.* preceding abstract), washed by decantation with hot water and dissolved in a known volume of a warm mixture of 0·5 N sulphuric acid and 0·25 N (0·5 per cent.) hydrogen peroxide which is added from a burette till it is slightly in excess. The acid used up according to the equation $Cu_2O+H_2O_2+2H_2SO_4=2CuSO_4+3H_2O$ is determined by back-titration of the excess with 0·5 N sodium bicarbonate solution in the presence of 100 c.c. of water and 3 drops of methyl orange, the end-point being a permanent yellow-green colour. The factor 1·020 then gives the excess of acid, and the amount consumed, multiplied by the factor 0·015378, gives the amount of copper in the cuprous oxide. The sugar solution should not be stronger than 0·5 per cent., and the hydrogen peroxide-acid mixture should not be kept for longer than one month. J. G.

Oncoba echinata Oil as a Substitute for Chaulmoogra Oil. E. André and D. Jouatte. (*Quart. J. Pharm.*, 1928, **1**, 235–236; *L'Union Pharm.*, 1928, **69**, 129.)—*Oncoba echinata*, gorli, or katoupo, a native of Sierra Leone, French Guinea, and the Ivory Coast of West Africa, belongs to the N.O. *Flacourtiaciae*. The fruits are globular and prickly, like chestnuts. When ripe, they dehisce and show yellow seeds about the size of a grain of wheat, embedded in a

thick pulp. These seeds are the smallest seeds known of the chaulmoogra class. Natives use them bruised as an application in various skin diseases. Although a section shows no evident oil, they yield 50 per cent. of oil on extraction with ether. The ether-extracted oil had sp. gr. 0·9286 at 30° C.; $n_D^{31°}$ 1·4740; α_D +56° 10′; m.pt. 40–42° C.; saponification value 184·5; iodine value (Hanus) 98. Gorli oil affords a satisfactory substitute for Asiatic chaulmoogra oil in the treatment of leprosy. Chaulmoogric acid constitutes 75 to 80 per cent. of its weight. It also contains 10 to 12 per cent. of a new liquid fatty acid, *gorlic acid*, $C_{18}H_{30}O_2$, a colourless liquid which turns slightly yellow on contact with air; sp. gr. 18°/0° C. 0·9364; $n_D^{19°}$ 1·4783; α_D +199·5; iodine value (Hanus), 169·6. Its therapeutic value has yet to be investigated. Gorli oil also contains a small amount of palmitic acid. P. H. P.

Determination of the Iodine Value of Camphor Oil. S. Yamada and T. Koshitaka. (*J. Soc. Chem. Ind.* (Japan), 1928, **31**, 141B.)—Three methods of determining the iodine value of camphor oil have been studied, those of Hübl and Wijs (iodine) and that of Rosenmund (bromine-acetic acid). The iodine solutions were only slowly absorbed, whilst the bromine solution was rapidly absorbed. In the latter case the conditions of the determination should be:—Temperature, 20°; time, 10 mins.; excess of halogen, over 90 per cent. Camphor oil absorbs large amounts of halogen, whereas camphor itself only absorbs little. R. F. I.

Determination of the Oil Content of Crude Camphor. S. Yamada and T. Koshitaka. (*J. Soc. Chem. Ind.* (Japan), 1928, **31**, 142B.)—The iodine value of camphor may be taken as an index of the camphor oil content. The method recommended is that of Rosenmund, in which one grm. of the crude camphor is dissolved in 5 c.c. of carbon tetrachloride. With samples containing over 2 per cent. of oil the weight of camphor should be reduced so that the excess of halogen is kept at over 90 per cent. On carrying out the determination on three grades of camphor the following percentages of oil were found:—B, 2 per cent.; BB, 0·6 per cent.; and refined, 0·06 per cent. R. F. I.

Composition of Strychnine Phosphomolybdate. C. Antoniani. (*Giorn. Chim. Ind. Appl.*, 1928, **10**, 408–410.)—As obtained by Embden's method (*Z. physiol. Chem.*, 1921, **113**, 138–145), strychnine phosphomolybdate differs slightly from that obtained after washing with 10 per cent. nitric acid solution (ANALYST, 1928, 405), the composition in the latter case corresponding with the formula, $11MoO_3,H_3PO_4,(Str.)_3,2HNO_3$. The most favourable proportions of the reagent are 350 parts of MoO_3, 2500 parts of HNO_3 and 10 parts of strychnine per 1 part of P_2O_5. The value 0·0257 for the conversion of the weight of the precipitate into P_2O_5 is confirmed. T. H. P.

Determination of Strychnine as Silicotungstate. E. Stuber and B. Kljatschkina. (*Quart. J. Pharm.*, 1928, **1**, 226; *Arch. Pharm.*, 1928, **266**, 33.)—A gravimetric method for the determination of strychnine consists in the

precipitation of the alkaloid as silicotungstate, the ignition of the precipitate, the weighing of the residue of silicon and tungsten oxides, and the use of a factor to convert the weight of residue to that of alkaloid. The precipitate has a constant composition. The method is as follows :—To the solution, which contains about 0·15 grm. of strychnine in about 80 c.c. of solution, are added 10 c.c. of 10 per cent. nitric acid and 8 to 10 c.c. of 10 per cent. silicotungstic acid solution. The solution is heated for 15 to 20 minutes in the water bath, then tested for completeness of precipitation, and allowed to stand for 18 hours. The precipitate is then filtered off through paper or through a Gooch crucible, washed with water containing a little acid until the filtrate gives no reaction with strychnine solution (and thus all silicotungstic acid is removed), dried ignited gently at first, and finally at a low red heat. The residue should be yellow or greenish-yellow ; if green, it must be oxidised with nitric acid. A factor of 0·422 is recommended for the calculation of the amount of strychnine—this includes an allowance for a small amount which remains in solution. P. H. P.

Volumetric Determination of Liquor Strychninae Hydrochloridi. J. Rae. (*Quart. J. Pharm.* 1928, **1**, 222–223 ; *Pharm. J.*, 1928, (4), **66**, 270.)—The following method, which can be used for the determination of basic strychnine and its salts, is described for the determination of *Liquor Strychninae Hydrochlor* :—Ten c.c. of the liquor are evaporated in a beaker on the water bath to about 5 c.c. to drive off the alcohol, then 5 c.c. of water are added, followed by 25 c.c. of $N/10$ potassium dichromate solution and 2 c.c. of dilute sulphuric acid, B.P. The mixture is left for 30 minutes, then transferred to a 100 c.c. graduated flask, the beaker washed out with distilled water, and the final volume in the flask is made up to 100 c.c. After shaking, the liquid is filtered, and 50 c.c. of the filtrate is treated with 1 grm. of potassium iodide and 3 c.c. of hydrochloric acid, and the liberated iodine is then titrated with $N/10$ thiosulphate solution with starch as indicator. $[25-(\text{No. of c.c. of } N/10 \text{ thiosulphate used} \times 2)] \times 0{\cdot}1356$ gives the percentage of strychnine hydrochloride in the solution.

P. H. P.

Biochemical

Nutritive value of Haddock and Herring (*Clupea harengus*). M. C. Kik and E. V. McCollum. (*Amer. J. Hygiene*, 1928, **8**, 671–693.)—Herring and haddock oils contain vitamins *A* and *D*, but haddock, a lean fish, is but slightly potent in this respect, whereas herring is much richer. Vitamin *B* appears to be present only in small quantities. The proteins of haddock and herring are poor supplements for the proteins of navy beans and peas, but have a supplementary value to the protein of oats and wheat, herring in each case being rather superior to haddock, and this value compares very favourably with that of steak, liver and kidney, although the latter also act as supplementary to legume proteins.

D. G. H.

Comparison of Raw, Pasteurised, Evaporated and Dried Milks as Sources of Calcium and Phosphorus for the Human Subject. M. M. Kramer, E. Latzke and M. M. Shaw. (*J. Biol. Chem.*, 1928, **79**, 283–295.)—Metabolism experiments have been carried out with children and adults as subjects in an effort to learn whether or not the calcium and phosphorus in various forms of milk are equally available for human nutrition. Efforts were made to have milk the only variable, and milk furnished as much of the total calcium as possible, and also much of the phosphorus. In order that differences might show, the total intake of calcium and phosphorus was kept near the minimum required for maintenance in the adults and below the amount required for optimum storage in the children. Figures show the calcium retention of the various children during the dried milk periods to have averaged only 53 to 71 per cent. as much as during their fresh milk periods, although the dried milk periods furnished an average of 94·5 per cent. as much calcium as did the fresh milk periods, and a little more phosphorus than the fresh milk periods diets ; likewise, phosphorus retention was somewhat lower. From experiments with five children it is evident that the child retains more calcium when it is supplied in fresh milk than when it is furnished in equal amounts by dried milk, other factors remaining unchanged. All adult subjects showed more favourable calcium balances when the fresh milk was the source of supply rather than dried milk. Pasteurised milk also gave less favourable calcium balances than did fresh milk. Further, the milk from cows kept in the barn gave less favourable calcium balances than did fresh milk from the rest of the herd. On the other hand, adult subjects using evaporated milk showed balances at least as good as when fresh milk was used. Since the amount of milk used furnished smaller proportions of the phosphorus of the diet, the results on phosphorus are necessarily less convincing, but, in general, phosphorus balances followed the trend of the calcium balance figures. P. H. P.

Oxidation of Dixanthydryl Urea, and a Micro Method for the Determination of Urea. J. M. Luck. (*J. Biol. Chem.*, 1928, **79**, 211–219.)—Xanthydrol is readily oxidised to xanthone, and it therefore occurred to the author to investigate the action of oxidising agents upon dixanthydryl urea as a basis for the determination of urea. It was found that dixanthydryl urea dissolves in sulphuric acid to give fluorescent solutions of a brilliant canary-yellow colour, which become colourless on oxidation with potassium permanganate. The end-point is readily determined under the optimum conditions, and with the use of these facts a quantitative volumetric method for the determination of urea has been developed, by which 0·1 mgrm. may be determined with an experimental error of about 5 per cent. Oxidation proceeds beyond the formation of xanthone. For the method 2 to 5 c.c. (5 c.c. for normal blood) of the Folin-Wu tungstic acid filtrate (Kiech and Luck, *J. Biol. Chem.*, 1928, **77**, 723) contained in a 15 c.c. centrifuge tube are diluted to 5 c.c. with water, and then 5 c.c. of glacial acetic acid and 0·5 c.c. of 10 per cent. xanthydrol in methyl alcohol are added, and the contents well mixed. (For the xanthydrol solution 10 grms. of xanthydrol were suspended in 90 grms. of pure

methyl alcohol, shaken at intervals during 3 days, and filtered.) After 1 hour the tube is centrifuged, the supernatant fluid decanted, and the precipitate of dixanthydryl urea washed once with 5 c.c. of a saturated solution of dixanthydryl urea in methyl alcohol to remove excess of xanthydrol, the tube again centrifuged, and the fluid removed by decantation. The excess of alcohol which clings to the precipitate and the wall of the tube is removed by drying for a few minutes at 100° C. Complete solution of the dixanthydryl urea being essential, the precipitate is pulverised by grinding it against the bottom of the centrifuge tube with a stirring rod, and then 8 c.c. of cold 1:1 sulphuric acid (equal volumes of water and concentrated acid) are added. The residue slowly dissolves to form a yellow solution which is washed with 32 c.c. of water into a 10 cm. white porcelain evaporating basin. The contents are heated to 70–75° C., and titrated at this temperature with 0·05 *N* potassium permanganate solution contained in a 5 c.c. burette, until the last tint of yellow has disappeared. The titration should be carried out in a bright white light, and a second porcelain basin containing 40 c.c. of water should be near (but not artificially illuminated) for purposes of comparison. The basin should be taken from under the burette and placed beside this standard after each addition of permanganate for the end-point to be determined. When near the end-point, an additional amount of the 1:1 sulphuric acid, equal to one-fourth of the volume of permanganate used, should be added in order to maintain an acid concentration of 10 per cent. (by volume). Not more than 3 c.c. of permanganate should be used in the titration ; somewhat beyond this point the relationship between the amounts of permanganate and urea ceases to be linear. Below this upper limit 1 c.c. of 0·05 *N* potassium permanganate = 0·093 mgrm. of urea. For the determination of urea in urine, 1 c.c. of urine is diluted to 100 c.c. in a volumetric flask. One c.c. of the diluted urine is transferred to a 15 c.c. centrifuge tube, 4 c.c. of water added, then 5 c.c. of glacial acetic acid, and 0·5 c.c. of the methyl alcohol solution of xanthydrol, and the procedure is then as above. The dixanthydryl urea required in a saturated solution during the determination was prepared as follows :—To 40 c.c. of 0·20 per cent. urea were added 140 c.c. of glacial acetic acid and 20 c.c. of 10 per cent. xanthydrol in methyl alcohol. The latter was added in 5 c.c. portions at 5 minute intervals. One hour and 25 minutes after the last addition, the mixture was centrifuged, and the crystalline precipitate washed with 100 c.c. of ethyl alcohol, and again centrifuged. The residue was washed on to a suction filter with 50 c.c. of ethyl alcohol, and dried at 60° C. When the new method was applied to muscle, trouble was experienced, and the tungstate procedure was therefore checked by the use of Tanret's reagent as another protein precipitant. Tanret's reagent is quite unsuitable if the determination of amino acids is desired, but it is, however, necessary to use this reagent as the protein precipitant for the determination of the urea content of muscle. Tanret's reagent and tungstic acid are equally satisfactory for the precipitation of the proteins of the liver and foetus. P. H. P.

Comparison of P Determinations as obtained by means of Hydrogen Electrode and Colorimetric Methods. C. G. Johnston. (*J. Biol. Chem.*, 1928, **79**, 297–307.)—The wide application of studies of the hydrogen ion concentration of blood and other body fluids suggests the importance of a simple method for these determinations. The standard hydrogen electrode method requires skill and a considerable amount of time and of blood, and various colorimetric methods have therefore been devised and used with corrections. Comparisons were made of the hydrogen ion concentration of dog sera, as determined by colorimetric methods, and the hydrogen electrode method. The method of Cullen (*J. Biol. Chem.*, 1922, **52**, 501), its modification by Hastings and Sendroy (*J. Biol. Chem.*, 1924, **61**, 695) and the dialysis method of Dale and Evans (*J. Physiol.* 1920–21, **54**, 167), in which the blood is dialysed and the indicator added to the dialysate, were the colorimetric methods used. The differences between the colorimetric readings and electrometric readings (called colorimetric corrections) were not constant. Corrections for sera from an individual animal after severe haemorrhage showed extreme variations, so much so that colorimetric methods cannot be used for accurate comparisons of individual determinations. A survey of the literature indicates that for a particular procedure the colorimetric corrections group themselves around an average value, and for statistical studies on human blood from normal and certain groups of pathological individuals colorimetric methods may be used with these average correction values, for they yield a high percentage of results which agree sufficiently closely with the hydrogen electrode values. It is doubtful at the present time if colorimetric methods should be used indiscriminately on all varieties of sera without adequate checking with the hydrogen electrode. For a comparison of individual determinations of either human or dog bloods colorimetric methods should not be used. P. H. P.

Dried Yeast and Yeast Extracts. S. G. Willimott and F. Wokes. (*Lancet*, 1928. **215**, 668–672.)—Studies on the nutritive value of wholemeal and white breads show that differences in protein content and calorific value are too small to be of practical significance, whilst the content of vitamin *B* is considerably less in white flour produced by modern milling processes than in wholemeal. The deficiency is only made good to the extent of about one-seventh by the use of yeast in making the white bread. Practical difficulties prevent the universal use of wholemeal bread, and the addition of dried yeast, which is several times more potent in vitamin *B* than the fresh yeast used in bread making, and is also cheap, is strongly advocated in the proportion of 2 to 4 per cent. of the flour. If the addition of large quantities of vitamin *B* to the diet is desired, a satisfactory potent yeast extract, varying in vitamin *B* potency only within small limits, may be used. Such an extract is readily made from brewer's yeast by heating it for some hours to 98° C. with 5 per cent. saline, cooling, filtering under moderate pressure, and storing the filtrate under refrigeration. In the following table of percentage compositions of yeast extracts, the figures in column 1 are a summary of those from

different workers; column 2 from Plimmer; column 4 and 5 from published figures:

TABLE I. PERCENTAGE COMPOSITION OF YEAST PRODUCTS.

		Dried yeast.		Yeast extracts.		
	Moist. yeast.	From marmite.	From experimental extraction.	Marmite.	Cerema.	Experimental extraction.
Nitrogenous matter, including protein	11–15	43·5	45·6	37·6	24·4	11·7
Carbohydrate	15–23	44·5	44·0	11·4	29·6	19·5
Fat	0·4–1·0	0·9	1·3	—	—	0·5
Mineral matter	2–10	8·6	5·0	24·2	17·4	19·1
Moisture	65–75	2·5	4·1	26·8	28·6	49·8
Total phosphorus (as P_2O_5)	0·5–1·0	—	1·6	4·2	—	2·0

TABLE II. VITAMIN *B* CONTENT (COMPOSITE FACTORS) OF DRIED YEAST AND YEAST PRODUCTS.

		Dried yeast.		Yeast extracts.	
	Moist yeast.	From marmite.	From experimental extraction.	Marmite.	Experimental extraction.
Minimum curative rat dose (grm.)	0·5–0·8	0·2	1	0·4–0·6	0·6
Minimum percentage in diet of rats	5–8	2	10	4–6	6
Minimum percentage in human diet	7–12	3	15	6–8	9

The figures in columns 1 and 2 are from Plimmer and other workers, and those in column 4 are averages of recent work by the authors and others. D. G. H.

Some Properties of Ergosterol. F. Wokes and S. G. Willimott. (*Quart. J. Pharm.*, 1928, **1**, 188–193.)—Ergosterol prepared from yeast gives with antimony trichloride blue colours very similar to the "vitamin" colours given by the same reagent with cod-liver oil, when concentrations of ergosterol above about 0·2 per cent. are used. Below this concentration only purple colours were observed. Quantitative measurement of these colours by means of the Lovibond tintometer showed the intensity of initial blue colour produced under standard conditions to run roughly parallel with the concentration of ergosterol, the type of curve obtained being similar to that which was secured with antimony trichloride on cod-liver oil by Wokes and Willimott (ANALYST, 1927, **52**, 515). Feeding experiments on the ergosterol failed to reveal the presence of vitamin *A*. Since the blue chromogen was about 10 times as concentrated in the ergosterol as in an oil whose minimum curative dose was 5 mgrms., the ergosterol was administered in doses of one-tenth of 5 mgrms., *i.e* 0·5 mgrm. Spectroscopic examination of the colours gave evidence of a difference in the characteristic absorption bands in the ergosterol blue as compared with the "vitamin" blue. There seemed to be a band with a head at about 500$\mu\mu$, with a possible error of $\pm 5\mu\mu$, but no band was discovered which could possibly correspond with the "vitamin" band at 617$\mu\mu$. Further work has shown that there seems to be a second "vitamin" band with

a head at about $528\mu\mu \pm 3\mu\mu$. Examination of samples of ergosterol which contained different amounts of zymosterol indicated that the blue colour is not due to the latter sterol, which is now known to be present in all samples of ergosterol prepared from yeast fat. It would be of interest to ascertain whether the destruction of the chromogen responsible for the production of the blue colour, by exposure to ultra-violet rays under the conditions usually employed to produce vitamin *D*, runs parallel with the conversion of the ergosterol to vitamin *D*. P. H. P.

Vitamin Content of Margarine. K. H. Coward. (*Lancet*, 1928, **215**, 726–727.)—Tests were made for vitamins *A* and *D* upon 14 samples of margarines purchased in shops, the tests extending over 17 months. At the same time similar tests were made on butters. These margarines have vitamin concentrate added during manufacture, and the results of the investigation showed that they were equal to the best summer butter as regards their vitamin *A* and *D* content. The tests for vitamin *D*, made by the modification of the " line test " of Steenbock and Black, showed a remarkably constant content of 1·25 units per grm., whilst only in one sample of butter was the figure so high, being usually between 0·75 and 1·0 unit. D. G. H.

Determination of the Antiscorbutic Value of Foodstuffs by Höjer's Method. M. Goettsch. (*Quart. J. Pharm.*, 1928, **1**, 168–174.)—A method, based on the histological changes in the teeth of guinea-pigs on a scorbutic diet, has been proposed by Höjer (*Acta pediat.*, 1924, **3** (suppl.) ; *Brit. J. Exp. Path.*, 1926, **7**, 356) for the quantitative determination of vitamin *C*, by which he claims that the minimum protective dose of an antiscorbutic substance may be measured accurately in the short time of 3 weeks. It seemed desirable, before adopting this method for the routine examination of the antiscorbutic potency of foodstuffs, to study whether the histological changes in the teeth were specific for scurvy, and also to what extent the results obtained by this method were in agreement with those of the method in general use of Zilva and Wells (*Proc. Roy. Soc.*, B., 1919, **90**, 505). The results show that the presence of scurvy in guinea pigs may be detected by histological changes in the incisor root. Even when scurvy could not be recognised either clinically or macroscopically, or by the microscopical examination of the ribs, the changes in the teeth were unmistakable, as pointed out by Zilva long ago. By Höjer's method of assay of the antiscorbutic potency of a substance, it is possible to determine the minimum protective dose of that substance ; but such variations occur within a group of animals on any one inadequate level of orange juice, that the value of an inadequate dose cannot be determined without the use of great numbers of animals. By this method special feeding need be carried on for only 2 weeks instead of 8 as in the other method ; hence there is less danger of animals dying from causes other than scurvy in the course of the test. Less than 2 weeks are required for the preparation of the teeth for microscopical study, so that information as to the antiscorbutic value of a foodstuff may be obtained in about 4 weeks' time. Tables of results obtained indicate that, according to Höjer's method, 5·0 c.c. of bitter orange juice (the minimum

protective dose) are equivalent to 3·0 c.c. of sweet orange juice, whereas, according to the method in general use, 3·0 c.c. of bitter orange juice are equivalent to 1·5 c.c. of the sweet. The results are thus seen to be in close agreement, but the minimum protective dose is greater in each case when determined by the Höjer method.

P. H. P.

Bacteriological.

Essential Oils as Anti-ferments. E. H. Harvey. (*Am. J. Pharm.*, 1928, **100**, 524–529.)—The percentage and efficiency of 32 typical essential oils as anti-ferments was tested by using 5 c.c. of a one per cent. aqueous solution of the oil, and basing the efficiency on the anti-hydrolysing power of the oil in a yeast and sugar solution at the end of 8 hours. The following results, expressed as percentage efficiency, were obtained *inter alia* :—Rosemary, 6·8 ; fennel, 8·8 ; turpentine, 10·0 ; lemongrass, 10·0 ; anise, 10·8 ; lemon, 10·8 ; orange, 12·8 ; eucalyptus, 13·0 ; mace, 13·6 ; juniper, 16·8 ; caraway, 18·5 ; sassafras, 18·5 ; celery seed, 20·0 ; camphor, 20·0 ; birch, 20·5 ; clove, 25·0 ; lavender, 26·0 ; peppermint, 28·0 ; cedar, 28·4 ; bergamot, 29·6 ; thyme, 30·8 ; pennyroyal, 39·0 ; wintergreen, 44·0 ; cinnamon, 48·3. By adhering to definite conditions reasonably concordant results are obtained. The anti-ferment efficiency and also the colour of oils is effected if they are stored in transparent glass containers, owing to absorption of ultra-violet radiations. The anti-fermentative action of vinegar, due to acetic acid, is rapidly effective at concentrations of 1·5 per cent. and above.

D. G. H.

Preservation of the Amylase Solution of *Aspergillus oryzae*. K. Oshima. (*J. Soc. Chem. Ind.* (*Japan*), 1928, **31**, 180 B.)—The preserving power of various disinfectants was tried on the enzyme solution produced by cultivating *Aspergillus oryzae* on steamed wheat bran for 2 days at 30° C. The following antiseptics were found suitable :

	Per cent. in enzyme solution.
Cresol	0·15–0·40
Lysol	0·5–2·0
Phenol	0·4–1·5
Thymol	0·05–0·20
Phenol + cresol	0·3P + 0·1C; 1·0P + 0·2C.

The following were found unsuitable :—Chloral, chloroform, clove oil, formalin, potassium cyanide, mercuric chloride, sodium fluoride, sodium benzoate, salicylic acid, toluene and xylene.

R. F. I.

Toxicological and Forensic.

Determination of Carbon Monoxide in Blood. W. M. M. Pilaar. (*Chem. Weekblad*, 1928, **25**, 509–513.)—Methods for the determination of the relative and absolute amounts of carbon monoxide in blood are outlined and criticised, and a micro-modification of the method of Cohen Tervaert (*Biochem. J.*,

1925, **19**, 300) is described which may be carried out in 30 minutes on 1 c.c. of blood, and is accurate to within 0·001 c.c. of carbon monoxide per c.c. of blood. The blood is haemolysed in an evacuated flask, in the presence of 1·5 c.c. of water, treated with 1 c.c. of a cold saturated solution of potassium ferricyanide and warmed on the bath at 40° C. for about 30 minutes. By means of a current of carbon monoxide-free air, the gas is conveyed over iodine pentoxide heated at 150° C., and the iodine liberated, absorbed in potassium iodide solution, is titrated with a 0·001 *N* solution of sodium thiosulphate (1 c.c. = 0·056 c.c. CO at 0° C. and 760 mm.). The titration from a blank experiment is deducted. With human blood coagulation may be carried out by dropping 1 c.c. of sample (15 drops) into 1 c.c. of a 1 per cent. solution of sodium citrate contained in a graduated tube. It is shown that the use of citrate does not affect the results, but in such cases it is advisable to take about 3 c.c. of water for the haemolysis. A full description of the apparatus is given. J. G.

Organic Analysis.

Preparation of Soluble Starch and an Improved Polarimetric Lintner Method. H. C. Gore. (*Ind. Eng. Chem.*, 1928, **20**, 865–866.)—The soluble starch is prepared by mixing 1 part by weight of potato starch with 1·5 parts of 13 per cent. hydrochloric acid ; after six days' contact with the acid the starch is collected on a filter, washed with water, then suspended in water, neutralised with ammonia, again collected and washed until free from chloride, and dried in a current of warm air. To determine the diastatic activity of a malt infusion, 100 c.c. of a 6 per cent. starch solution are treated with 2 c.c. of Walpole's acetate buffer (8 c.c. of *N* acetic acid and 12 c.c. of *N* sodium acetate solution per 100 c.c. of water) and the malt infusion is so prepared that each c.c. represents 50 mgrms. or a known multiple of 50 mgrms. Fifty c.c. of the buffered starch solution, 1 c.c. of concentrated ammonia and 5 c.c. of the malt infusion are mixed, filtered if necessary, and polarised. Five c.c. of the malt infusion and 50 c.c. of the buffered starch solution, both at 21° C., are then mixed and kept at this temperature for such a time that the polarisation does not decrease more than 11·3° V. (using a 4 dm. tube). One c.c. of strong ammonia is then added, the solution is filtered, and polarised. The diastatic power is calculated from the formula

$$L = 100\ D/t \times l \times c,$$

where L is degrees Lintner, D the decrease in polarisation due to 250 mgrms. of sample, t time in hours, l the length of tube in decimeters, and c a constant determined experimentally. The factor c (= 4·6) was found by the use of a malt infusion of known diastatic power (Lintner's gravimetric method) and Kahlbaum's dry soluble starch. W. P. S.

The Thiocyanogen Value of Fats. H. P. Kaufmann. (*Seifensied. Ztg.*, 1928, No. 35. Reprint.)—Gerber (*Seifensied. Ztg.*, 1928, **55**, 27) has described a

method of dehydrating the glacial acetic acid for the preparation of the thiocyanogen solution for the author's method (ANALYST, 1926, **51**, 157, 264). This consists in adding acetic anhydride to the acetic acid, and heating the mixture under a reflux condenser. The author and Normann have confirmed the value of the suggestion, but point out that the quality of the glacial acetic acid has also an influence on this modified method. The following simplified method of preparing the reagent is recommended :—Glacial acetic acid (Kahlbaum, 99 to 100 per cent.) is mixed with 10 per cent. of acetic anhydride and allowed to stand for some time. About 5 grms. of lead thiocyanate are then put into a flask with a well-fitting stopper, and the flask is filled up with the mixture and allowed to stand, the longer the better. Then, before use, about 0·6 c.c. of bromine is run into the flask, which is thoroughly shaken until the liquid is colourless, after which it is filtered. With the reagent thus prepared the end-point of the thiocyanogen absorption is sharply indicated, even in the case of highly unsaturated oils.

Calculation of the Saturated Constituents of a Fat from the Thiocyanogen Value.—In the case of fats the glycerides of which contain unsaturated fatty acids with the same number of carbon atoms in the molecule, and which react with thiocyanogen in the same way, the amount of saturated constituents can be calculated with close approximation to the truth from the thiocyanogen value. For example, if a fat contains oleic acid and linolic acid, both of which require 1 molecule of thiocyanogen for saturation, the slight difference in the molecular weight (282 as compared with 280) introduces only a negligible error, and the amount of saturated constituents can be found directly by means of the equation— $x = 100 - 1{\cdot}158 \times$ thiocyanogen value. The method thus affords a check upon the separation methods usually employed by means of lead or thallium salts, etc., since these methods, as is well known, give the acids solid at the ordinary temperature, not the unsaturated acids. A comparison of the calculated result with a sample of sesame oil, as compared with the values obtained by separation of the solid acids, gave the following results. The thiocyanogen value of the oil was 75·7 (or, allowance being made for the unsaponifiable matter, 75·84). By use of the formula given above the amount of unsaturated constituents in the mixed fatty acids was found to be (1) 12·3, (2) 12·2 per cent. The amount of solid constituents actually determined by the usual lead salt and alcohol method was (1) 11·76, (2) 11·51 per cent.

In Bertram's method (*Diss. Delft*, 1928) all the unsaturated constituents (not merely those solid at the ordinary temperature) are determined. The fatty acids are first converted into potassium soaps, which are then oxidised in alkaline solution by means of potassium permanganate, and the saturated fatty acids extracted from the resulting hydroxy acids by means of petroleum spirit, and purified by being twice converted into the magnesium salts. The mixed fatty acids of the sesame oil yielded by this method 12·5 per cent. of saturated acids, which agrees well with the calculated value. Analogous results were obtained with other fats.

Determination of the Concentration of Dilute Glue Liquors by means of the Immersion Refractometer. A. C. Hart. (*Ind. Eng. Chem.*, 1928, **20**, 870–871.)—Results are recorded which show that the immersion refractometer is useful in determining the percentage of glue in dilute liquors (up to about 5 per cent.). As high grade glues have a somewhat higher refractive index than low grade products, the approximate grade of a glue should be known when determining the concentration of its solution, if extreme accuracy is desired. W. P. S.

Inorganic Analysis.

Sensitive Test for Silver. F. Feigl. (*Z. anal. Chem.*, 1928, **74**, 380–386.)—The silver salt of dimethylamino-benzylidene-rhodamine,

is formed in acid, neutral, or ammoniacal silver solutions when they are treated with an acetonic solution of the reagent (0·03 grm. in 100 c.c.) as a flocculent reddish-violet precipitate. For the detection of traces of silver, the liquid is shaken with ether, carbon disulphide, or carbon tetrachloride for the removal of the excess of base, which dissolves with yellow colour in the solvent, leaving the silver precipitate as a coloured film at the plane of contact of the two layers. The limit of sensitiveness of the reaction is 1 : 5,000,000. When a silver nitrate solution is precipitated with an excess of sodium chloride, the filtrate gives a positive silver test with the new reagent. Directions for its preparation from rhodanine are given. W. R. S.

Colorimetric Determination of Iron with Potassium Thiocyanate. L. S. v.d. Vlugt. (*Chem. Weekblad*, 1928, **25**, 495–496.)—The following modification of the Dutch Codex method for the determination of iron in water produces the maximum colour, and eliminates the effects of salts and organic substances. The sample (100 c.c.) is heated for 5 to 10 minutes with 10 c.c. of dilute sulphuric acid (1 : 5) and 3 to 4 c.c. of a 5 per cent. solution of iron-free potassium persulphate. If the solution is still coloured it should be heated for another minute in the presence of a little more reagent, cooled, filtered, and the filtrate made up to 90 c.c. The colour produced after the addition of 10 c.c. of a 20 per cent. solution of potassium thiocyanate is then matched against a suitable quantity of a standard solution, prepared in the usual way, and oxidised in the manner already described. J. G.

Diphenylcarbazide as a Test for Chromium. N. M. Stover. (*J. Amer. Chem. Soc.*, 1928, **50**, 2363–2366.)—A reagent prepared by dissolving 0·2 grm. of diphenylcarbazide in 10 c.c. of glacial acetic acid and diluting to 100 c.c. with 95 per cent. ethyl alcohol, furnishes a very sensitive test for chromium. A stock solution of potassium dichromate containing 0·01 grm. of chromium per c.c. was

diluted to a definite concentration. A volume four times that required for the test was treated with 4 c.c. of 6 *N* ammonium hydroxide solution, and the liquid diluted to 100 c.c. and divided into four equal portions. One was acidified with 6 *N* sulphuric acid, an excess of about 2 c.c. being added, followed by addition of 3 to 5 c.c. of ether and 3 c.c. of 3 per cent. hydrogen peroxide solution ; the mixture was shaken vigorously, and the appearance of the ether layer noted. The three remaining portions were acidified with sulphuric, acetic and citric acids, respectively, and 2 c.c. of the diphenylcarbazide reagent added to each, the liquids being examined after 10 minutes. The lowest concentration of chromium detectable by the ether and hydrogen peroxide method was 1:250,000, whilst with the diphenylcarbazide distinct violet or violet-red colorations were obtained at dilutions of 1:100,000,000 to 250,000,000, 1:71,000,000 or 1:12,500,000, according as sulphuric, acetic, or citric acid was present.

Similar tests were made with chromic nitrate, from which aluminium was removed by precipitation as hydroxide. The highest dilution of chromium giving a positive test with diphenylcarbazide and acetic acid was 1:1,666,000, whilst a dilution of 1:250,000 failed to respond to the ether and hydrogen peroxide test. Acetic acid was found best in this case, because some of the blanks gave positive results in presence of sulphuric acid, possibly owing to very minute traces of chromium in the salts used. Moreover, acetic acid is used to acidify the filtrate from the aluminium precipitate prior to testing it for zinc by means of potassium ferrocyanide. T. H. P.

Modified Confirmatory Test for Aluminium. E. H. Pañganiban and F. A. Soliven. (*J. Amer. Chem. Soc.*, **1928**, **50**, 2427–2428.)—In the confirmatory test for aluminium given by Noyes (*Quantitative Chemical Analysis*, 1923, 190), the precipitate formed by ammonium hydroxide is dissolved in nitric acid, the liquid being then treated with a few c.c. of water and a few drops of cobalt nitrate solution, together with ammonium hydroxide solution to reprecipitate the aluminium. The precipitate is washed as free as possible from sodium salt, and the filter paper rolled up with the precipitate in a platinum wire and heated until the carbon is burnt off ; a blue residue indicates aluminium. After the reprecipitation, the authors recommend filtration through a filter paper with a few asbestos fibres at the point of the cone. Only the asbestos fibres, holding the precipitate, are hooked in a platinum wire and burned. This procedure allows of the ready detection of 0·0002 grm. of aluminium, and answers even when the aluminium precipitate is not washed at all. (*Cf.* Otto, ANALYST, **1926**, **51**, 478.) T. H. P.

Separation and Determination of Chromium, Iron and Aluminium. K. K. Järvinen. (*Z. anal. Chem.*, **1928**, **75**, 1–16.)—The solution (100 to 200 c.c.) is treated with 1 to 2 c.c. of bromine and, when this has dissolved, gradually with an excess of about 10 c.c. of 2 *N* sodium hydroxide during agitation. After about 15 minutes the precipitate is re-dissolved in the solution in a minimum of hydrochloric acid, after which the solution is once more made alkaline gradually. After

a while the liquid is heated on a water bath, acidified with 30 to 40 c.c. of 2 *N* hydrochloric acid, diluted to 200 to 300 c.c., and boiled till the bromine is completely expelled (moist iodide and starch paper test). The hot solution is then treated with ammonium phosphate equivalent to the iron and aluminium present, and precipitated with strong ammonia, drop by drop. After cooling, the volume is made up and an aliquot part of filtrate strongly acidified (5 c.c. H_2SO_4 per 100 c.c.), cooled, treated with potassium iodide, and titrated with thiosulphate. One c.c. of 0·1 *N* solution = 0·001733 grm. Cr. The following method for the determination of the iron is recommended as accurate. The ammonia precipitate obtained above, which need not be washed, is dissolved in hydrochloric acid, the small amount of chromate reduced with a minimum of sodium bisulphite, and the iron re-oxidised with a few c.c. of bromine water, the excess of which is boiled off as before. The solution is transferred to a glass-stoppered retort, and 1 to 2 grms. of potassium iodide and pumice powder added. The liberated iodine is distilled into a cooled flask containing 50 c.c. of water and 10 c.c. of 2 *N* sodium hydroxide, into which the retort tube dips. The distillation is continued for 5 to 10 minutes after the violet fumes have been absorbed. The cold distillate is acidified and titrated with thiosulphate. Phosphoric acid is determined in a separate portion, and alumina by difference after determination of the sum of the oxides by ammonia precipitation in a third portion. W. R. S.

Use of Picric Acid as an Artificial Standard in the Colorimetric Determination of Silica. E. J. King and C. C. Lucas. (*J. Amer. Chem. Soc.*, 1928, **50**, 2395–2397.)—Examination by Diénert and Wandenbulcke's method (ANALYST, 1923, **48**, 398) of silicate solutions prepared from various forms of silica, shows that the intensity of the yellow colour given by a silicate solution containing 0·05 grm. of silica per litre is equivalent to that of a solution of picric acid containing 0·0256 grm. of the vacuum-dried, chemically pure acid per litre. T. H. P.

Physical Methods, Apparatus, etc.

Luminescence of Oils and Fats. A. Van Raalte. (*Chem. Weekblad*, 1928, **25**, 544–545.)—The fact that refined oils, unlike crude oils, usually show luminescence, is attributed to the presence in the latter of a substance which inhibits luminescence and which is removed during the refining process. The colouring material in coconut oil probably explains its exceptional behaviour. Other individual cases are discussed, and it is suggested that the anti-luminescent substance in crude oils is associated with the presence of sterols or vitamins. (*Cf. Chem. Weekblad*, 1926, **23**, 51, and Feder and Rath, *Z. Unters. Lebensm.*, 1927, **54**, 321.) J. G.

Molecular Weights of Saturated Vapours by the Effusion Method. H. Eyring. (*J. Amer. Chem. Soc.*, 1928, **50**, 2398–2401.)—A simple apparatus is described which allows of the determination of the molecular weight of a gas or

saturated vapour in less than 30 minutes and involves no weighings. The apparatus requires no washing out and may thus be attached permanently to a wall. The operations consist in evacuating the whole apparatus with a Hyvac pump, admitting the liquid to an external chamber, opening a stopcock connecting this chamber with the receiving vessel (about 2·5 litres) by way of an orifice (about 0·1 sq. mm. area), and measuring the time required for the pressure in the receiving chamber to reach a predetermined value. The same procedure is followed with air, the pressure of which in the external chamber must be adjusted, by means of a stopcock, to remain constantly equal to the vapour pressure of the liquid under examination. The times found for isopropyl alcohol and air were respectively 202 and 140 seconds; molecular weight of isopropyl alcohol $= 202^2 \times 28{\cdot}8 \div 140^2 = 60$. If the pressure in the receiving chamber is allowed each time to rise in the receiving chamber to one-half the vapour pressure (the pressure on the side containing the liquid), the molecular weights of liquids of different vapour pressures may be compared without calibration with air. The results obtained by this method give no indication of appreciable association of saturated water vapour, or of the vapour from hydrochloric acid of constant boiling point, or of the vapours of organic compounds. T. H. P.

Reviews.

THE CHEMIST'S YEAR BOOK, 1928. Thirteenth Edition. Edited by F. W. ATACK, D.Sc. Pp. 1173 and Index. Manchester: Sherratt & Hughes. Price 21s.

This valuable book has now reached the thirteenth edition in fourteen years, which proves, if proof is necessary, that it meets a very definite demand. Few chemists need to be reminded of the vast amount of information on a wide range of subjects contained in this small volume; how vast is scarcely realised until one goes through it page by page. The high standard attained is doubtless due in some measure to the wise course which, as is obvious from his preface, the editor adopts, of profiting by constructive criticism. The task of revision has been carried on so well from year to year that only minor points now call for criticism, and these are mostly in the direction of extension rather than correction.

Additions have been made to various sections, and a new one on "The Determination of Hydrogen Ion Concentration" by Dr. E. M. Crowther has been included. The section on "Oils, Fats and Waxes" has been completely revised.

The sections are well written; that on "Qualitative Analysis" may be specially mentioned in this connection. The author's "Notes on the Group Separations" cannot fail to be of great assistance to those who wish to be informed as to the reasons for the directions given. If there be some who are content to remain in ignorance of the principles involved, their vocation does not lie in the direction of analytical chemistry. A word of appreciation is due to the writer of the section

on "Water Analysis," because he expresses a candid opinion on the value of one of the tests which he describes, *viz.* the soap test. His words are, it may be "erratic and misleading." Such an exhibition of frankness is as welcome as it is rare; his example might, with advantage, be more frequently imitated. Speaking generally, it seems far too common for authors of text books to present one process after another without in any way indicating what their relative values are.

In the notes on Group II (p. 530) if the fact were mentioned that lead, as well as cadmium, can be held up by excess of hydrochloric acid, it might save a beginner some trouble. On page 557 acids of strength 2 *N* seem rather too strong if they are intended to be used for quantitative analysis. In the qualitative turmeric test for boric acid, on p. 515, it is suggested that it would be better to have a little free hydrochloric acid present. The paragraph on the interpretation of the results of water analysis might very well be extended somewhat, so as to indicate the significance of total solids, nitrates, nitrites, chlorides, etc. Qualitative tests would appear to be a fit introduction to the section on "Ultimate organic analysis," or in case any such tests occur elsewhere, a short note might be given directing attention to the place where they could be found. To put a dish containing liquid to be evaporated "on the top of the air oven" (p. 733) is indefinite as regards temperature, depending on the type of oven used, and may mean evaporation at nearly the temperature of the laboratory in these days of well-insulated electric drying ovens. The index of a work of this kind must inevitably be a difficult task, and mentioning a point where it falls short of perfection by no means proves that it is not good. A small section on "Dissociation constants" is included, but it is not mentioned under "Dissociation" or "constants" in the index.

Misprints are very few. The specific gravity of sodium acetate solutions occurs on p. 71, but is indexed as p. 72. On page 847 0·5 per cent. occurs for 0·05 per cent. as the possible error of a method for the estimation of borates. "Ovum" is printed for oven on p. 797, while the figures marking page 636 are inverted.

The reviewer is encouraged by the editor's implied permission to offer constructive criticism, to mention the following points. If it could be arranged as a general rule that processes, especially the longer ones, could be preceded by one or two short sentences, stating briefly the principle involved, it would, in the writer's opinion, be an improvement. This applies particularly to the section on "Oils, Fats and Waxes." It might be said that it is a useful exercise for a reader to elucidate the principle for himself, but, if the reviewer's experience be typical, sufficient mental exercise may be obtained by selecting, modifying and applying various processes, when problems for solution follow quickly one on the heels of another. The time taken in sorting out the principles might conceivably add variety, but not leisure, to life.

The insertion of more references to original papers would enable anyone to follow up any desired line of investigation, since detailed information on all points cannot reasonably be expected in a book which covers so much ground. All references could not, of course, be given, but more of the principal ones would

serve as a beginning, and additional ones would be found in the original papers themselves. The usefulness of the book would thereby be increased as a starting point for wider fields.

No doubt in the next edition the various sections on Fertilisers, Feeding Stuffs, Dairy Products, etc., will be brought into line with the latest regulations, which probably appeared too late for inclusion in the present volume.

On the whole, it may be said that the book is a unique collection of information on many branches of the domain of chemistry, and the material is presented in a manner which renders it easily available. J. R. STUBBS.

IMPURITIES IN METALS. THEIR INFLUENCE ON STRUCTURE AND PROPERTIES. By COLIN J. SMITHELLS, M.C., D.Sc. London: Chapman & Hall. Price 18s.

The title of this book is rather modestly misleading, for not only are impurities and their influence discussed, but also the practice of adding small amounts of "impurities" with a definite object in view. A most valuable and lucid chapter presenting results of recent work on *X*-rays and the structure of metals quite outside the title field is included, and this chapter alone should give the book a distinct place in the literature on metallurgy.

The author deals in sequence with the structure of pure metals and alloys and the influence of minor constituents on structure, mechanical properties and the corrosion of metals.

It is assumed that the reader has some knowledge of this branch of metallurgy, but the general style maintained throughout the book is reminiscent of a series of well considered lectures enhanced by an apt choice of examples generously illustrated by reproductions of micrographs, the whole covering a wide range of metals.

Impurities dealt with are broadly classed under metallic, non-metallic and gaseous constituents.

The views expressed as to behaviour of these various constituents are brought into line with the most recently available work. As an example, Whiteley in 1925 (*J. Iron and Steel Inst.*, 1) and 1927 (*id.*, 11) put forward the view that particles can move bodily, as opposed to solution, diffusion and re-precipitation, and it is of interest to note that the author subscribes to the same opinion, quoting in particular, the behaviour of cuprous oxide in copper, chromic oxide in chromium, and thoria particles in tungsten.

Again, the chapter dealing with the influence of minor constituents on the corrosion of metals successfully presents a brief resumé of the views held as the result of an enormous mass of work done in this field. Here, as throughout the book, the reader has guidance for selection of literature on the subject and notably, reference is made to the standard work of U. R. Evans.

There are a few slips which have escaped notice. On page 59 it is stated quite definitely that carbon is insoluble in α iron, but on page 118, in discussing electrical properties, it is noted that this metal can hold 0·02 per cent. of carbon in solution at ordinary temperatures. On page 142 slag inclusions in wrought iron are referred to as phosphides and silicides, having been previously correctly described on page 67.

A minor impeachment might be suggested in the sufferance by repetition of the effect of arsenic in copper, but these criticisms are of slight magnitude in proportion to the value of the book, which can be recommended with confidence.

GEO. R. THOMPSON.

INDUSTRIAL CATALYSIS. By STANLEY J. GREEN, M.A., A.I.C. Pp. xii+507. With 19 Text Figures. London: Ernest Benn Limited. 1928. Price 50s. net.

Berzelius was the first to appreciate clearly from the accumulated data at his disposal, that certain chemical reactions involve the principle that a substance may cause a chemical change without itself apparently participating in the change. All such similar actions he classed under the term "Catalysis," and despite developments which have accrued since that time, we cannot well improve on his definition.

A period of systematic discovery followed, during the course of which it became abundantly realised that catalysis was a principle of remarkable universality rather than one to excite curiosity and astonishment, and this view culminated in the opinion expressed by Ostwald that there is probably no type of chemical reaction which cannot be influenced catalytically. Gradually this period merged into one where the exploitation of the economic possibilities of catalysis became dominant. This development, moving rapidly in the first decade of the present century, received great impetus during the world war. To-day we are witnessing new developments of far-reaching economic, nay, even of social importance, in this field of chemical activity.

After a preliminary survey in the first chapter, the author deals in Chapter II with the phenomena of catalysis. Chapter III treats of physico-chemical theory: such familiar matter as the Law of Mass Action, Molecular Reactions, the Principle of Le Chatelier, the van't Hoff Equation and the Nernst Heat Theorem are discussed. Chapter IV deals with theories of catalysis. The view currently accepted is one which is a compromise between the Intermediate Compound Theory and the Adsorption Theory. In Chapter V the subjects of Oxidation and Combustion are presented to our notice. Much of importance on such subjects as selective combustion, surface combustion and the many known cases of partial combustion of a great variety of organic compounds is presented to us. In this respect the work on the combustion of carbon monoxide, owing to the toxic properties of this gas, is of more than passing importance. Chapter VI deals with the subject of Nitric Acid and describes the development of the catalytic process in U.S.A., in Great Britain and in Germany. During the war ammonia oxidation plants were in operation in a great part of Europe though in this country the application of the process has been confined to the production of oxides of nitrogen for such purposes as the manufacture of sulphuric acid by the lead chamber method. The application in this way has effected a marked saving in the quantity of sodium nitrate hitherto used at sulphuric acid works. This chapter is full of interest and, incidentally, is the only one in the book to which a bibliography has been appended.

Chapters VII and VIII are devoted to Hydrogen and Hydrogenation and Processes of Hydrogenation. These two chapters contain a mass of detail and together make up one-third of the book. There are, notwithstanding the space allotted to this part of the work, serious omissions to be noted. The hydrogenation of carbon disulphide, and of phenols and cresols is of sufficient commercial importance to merit much more detailed treatment than the author has seen fit to accord. In regard to the hydrogenation of fatty oils, no reference whatever is made to the work of Bolton and Lush in respect of the now very familiar continuous process in which the nickel turnings used in the process, can be reactivated by anodic oxidation followed by reduction. The process is characterised by several novel features, has been in successful commercial use for several years, has been the subject of several patents, and a considerable technical and scientific literature has accumulated in reference to it. It represents the most notable advance in this branch of technology in recent years, yet receives no mention in the volume under review. Another curious omission is all reference to the work of Moore, A. S. Richardson and a number of other investigators on the selective action of a nickel catalyst in the hydrogenation of fatty oils. Moore showed in 1919 that there is a selective action and also that definite amounts of an isomer or isomers of oleic acid are formed. Both these points are of considerable industrial importance.

Chapter IX deals with Ammonia, and is better than some of the other chapters, in that it gives more details of technical development. The Haber and the Claude processes and their several modifications are treated somewhat fully. The next chapter deals with Dehydrogenation, in its way quite as important as the subject of hydrogenation. The author treats only very sketchily, however, the work on the cracking of petroleum and petroleum hydrocarbons; this is surprising on account of the very considerable literature which is available, and on account of the extent to which cracking operations are in use and of their industrial importance. The manufacture of formaldehyde is, however, dealt with more fully, together with such subjects as the dehydrogenation of amines, alcohols and other allied substances. In Chapter X, under the head of Dehydration, have been collected many data relating to the manufacture of olefines, ether, the formation of amines, dehydration between alcohols and acids, and so forth. Metallic oxides, particularly such as thoria, zirconia, urania, and others of comparative rarity, find application in much of this work.

The last chapter in the book deals with the Utilisation of Coal, and it is no exaggeration to say that the subjects embraced within this heading constitute the most important technical ones with which industry is to-day faced throughout the world. The complete elucidation of the many difficult problems involved in the successful technical application of the catalytic reduction of the oxides of carbon, the synthesis of petroleum-like bodies from water gas, the Fischer-Tropsch synthesis of hydrocarbons, and the Bergius and allied processes for the hydrogenation of coal are likely to be of far-reaching economic and political importance. The treatment the author has given them at the end of a lengthy

publication is, therefore, much too short to be of use other than as an indication of the main currents along which such work is moving.

Summarising the present volume as a whole, it will be found of great use as a work of reference to all engaged in the many problems which come within the orbit of catalysis. It is seriously marred by an almost complete absence of references to patent, scientific and technical literature of the past six or seven years, this defect being especially marked in some chapters. Furthermore, too much space is devoted to purely theoretical considerations and to details of no particular industrial importance. Many of the operations described have no industrial application at all or, alternatively, deal with substances of no great use or importance. The subject matter of the first four chapters, though so well done, bulks too largely in a work of this character. Considered purely as a work on Catalysis, it would have been easy to accord nothing but praise, but having regard to the title "Industrial Catalysis," one feels that the author has too often lost sight of the main idea. H. M. LANGTON.

THE MANUFACTURE OF ARTIFICIAL SILK. WITH SPECIAL REFERENCE TO THE VISCOSE PROCESS. By E. WHEELER. Being Volume I of a Series of Monographs on Applied Chemistry under the Editorship of E. H. Tripp, Ph.D. Pp. xv+150. London: Chapman & Hall, Ltd. 1928. Price 12s. 6d. net.

Let us say at once that the author, in treating of the manufacture of artificial silk, has done his work very well, and produced a brief, but clear, account of the various processes and machinery involved. To this part of the work 65 pages are devoted, and the text is illustrated by a number of drawings taken from patent specifications and manufacturer's designs. The remaining pages comprise short chapters devoted to the history and the chemistry of artificial silk, its properties, including dyeing properties, uses and the economics of its production. These chapters are more open to criticism from several points of view.

This being the first volume of a series of monographs on Applied Chemistry we may allow the editor to justify their production in his own words. He says "we find that our scientific periodicals stand in danger of being swamped by the mass of second and third rate material that is thought to be worth publishing. . . . . It is the first duty of the monograph writer to estimate the value of recent work upon the subject of which he writes: he must pick out the plums to save others from the indigestion that follows eating the whole pie." He goes on to say that "the work must be in a form that is both assimilable and attractive and the present series of monographs has been designed with these objects and ideals in view." In contrast to the violent metaphor of the indigestion and the pie, he concludes with an appeal in the words of Goethe that the authors should not be blamed too much if they do not attain these high ideals.

We are next presented with a foreword by Sir William Pope, and then the author in his preface makes acknowledgment to a number of firms and friends who have supplied him with illustrations of machinery or photomicrographs. So much for preliminaries.

In treating of the viscose process the author writes with clearness and authority. He deals with the raw materials and gives a flow sheet which enables the whole process to be followed for a charge of 100 kilos of cellulose. The various stages of the production of alkali-cellulose, formation of xanthate, etc., are given with well-selected illustrations. The spinning process is thoroughly considered, and another flow sheet summarises the text dealing with the finishing, from the cakes to the final bleached silk. The nitrocellulose and the cuprammonium processes are briefly explained in the same way, and a short chapter efficiently treats of the manufacture of cellulose acetate silk.

In the comparatively long chapters, X, XI, dealing with the properties of artificial silk, the author's style loses its authority and becomes irritating. He quotes authorities by name for the simplest facts, "Herzog says this, but recently Faust has shown that, etc." As an example, a quotation from page 81 may be given, "according to Hottenroth nitrocellulose silk has a strong glistening, metallic lustre, cuprammonium silk a strong glossy appearance, whilst cellulose acetate silk has a subdued glistening lustre like the nitrocellulose variety." This illuminating description might lead one to believe that the author himself had never seen a skein of nitrocellulose silk. He gives, however, with great brevity, the usual properties of the silks, illustrated by some good photomicrographs of sections of silk made by different processes and in different works. For the uses, and for the economic side of artificial silk production, he depends largely on the supplements recently issued by *The Times* and the *Manchester Guardian*.

In an appendix the author gives laboratory methods used for controlling the manufacture of viscose. For the estimation of the α-, β- and γ-cellulose in pulp he weighs the α-fraction and determines the β- and γ- fractions by the chromic acid method. Under viscose one convenient method in each case is given for the estimation of alkali, cellulose, total sulphur and xanthate soda. For this last he gives a useful method of his own which the reviewer has found quite satisfactory. A table for the chemical identification of the different artificial silks would have been more valuable if the composition of the reagents specified had been given.

I have not noticed many errors in the book, but it may be mentioned that the name Schweizer, which is so frequently mis-spelled in this country, is spelled wrongly in two different ways on page 2. The book is printed on a rather thick, clumsy paper and the references, although quite correctly put at the end of each chapter, are printed in a mixture of types which spoils the appearance of the pages on which they are set out; and the text, too, is spoilt by the large suffix numbers, *e.g.* (8) which are used to indicate the references instead of the more usual small figure above the line.

Although the book does not aim at giving such an account of the manufacture of artificial silk as would be useful to the works manager, it will be read by the student thinking of entering the artificial silk industry, and it can be well recommended for the general intelligent, so-called "non-scientific" reader. From the point of view of these readers its brevity is a great recommendation, and the book will undoubtedly find a useful place in the literature of artificial silk.

C. DORÉE.