

THE ANALYST.

OBITUARY.

DAVID HOWARD.

DAVID HOWARD, whose death occurred somewhat suddenly on November 14, 1916, was born at Tottenham on April 3, 1839. He was descended from Quaker ancestry, and was the son of Robert Howard and the grandson of Luke Howard, F.R.S., well known in his time as a scientist and philanthropist. David Howard's mother was one of the Lloyds of Birmingham, a granddaughter of the founder of Lloyds Bank.

The history of the origin of the famous business of Howard and Sons, of which at his death David Howard was the chairman, is of some interest.

About the year 1795 William Allen, F.R.S., who afterwards became President of the Pharmaceutical Society, succeeded to the pharmaceutical business of Joseph Gurney Bevan, of Plough Court, London, and went into partnership with one Samuel Mildred, with whom he continued the business in Plough Court, and at the same time established a chemical laboratory at Plaistow. In time it was found necessary to make other arrangements, so a fresh partnership was entered into between William Allen and Luke Howard, under the name of "Allen and Howard," this association being the starting-point and ultimately passing into the business of Howard and Sons.

Luke Howard and William Allen were both distinguished men, possessing similar ideas and tastes, and taking interest in many matters outside their immediate business. Luke Howard was one of the founders of the science of meteorology, and wrote several papers on that and collateral scientific subjects. One of his most important papers was on "The Climate of London," into which he introduced his nomenclature and classification of clouds, a classification accepted and in use at the present day. His partner, William Allen, was not only an able scientific man, but also one much interested in philanthropy. He was a friend of Clarkson, Wilberforce, and James Mill, and one of the strong opposers of slavery. It is not difficult therefore for those who knew David Howard, to trace in his own life and actions the influence produced by those early family friendships.

David Howard was educated in the first place in Southampton, at a school kept by a Mr. Crabbe, where he remained from 1852 to 1854. Afterwards he was sent to the Friends' School, Grove House, Tottenham, to be nearer where his parents lived, and at which he remained until about 1857.

Being now eighteen, he entered the firm as an apprentice, but about the same time proceeded to the College of Chemistry, then under the direction of the famous

Professor Hoffmann, where he studied the principles of general chemistry in preparation for his taking a position and share in the work connected with the firm at Stratford. Howard's time at the College of Chemistry must have been an agreeable and interesting one. Hoffmann at that time was exercising great influence on chemical teaching and investigation in this country and was attracting a large number of students to the College, many of whom have themselves become in later times distinguished teachers and investigators. Several of those remained Howard's friends through later life, and he always spoke of his time at the College of Chemistry with pleasant memories and affectionate allusion to the friends he had made during his student days at the College.

As well as receiving instruction in general chemistry under Hoffmann, Howard gained a practical knowledge of the business at the works, under the guidance of his father Robert, and his uncle John Elliot Howard. When first he entered the business Howard was associated more closely with his uncle, John, whom he assisted in the supervision of the laboratories specially devoted to the preparation and analysis of the cinchona alkaloids, thus becoming attached at an early period to this branch of the business, one in which he always took a special interest. This is indicated by the nature of the researches he carried out, originally with his uncle and afterwards by himself, on the active principles of the cinchona barks.

David Howard became a partner in Howard and Sons in 1860, and was made chairman of the Board of Directors in 1903, when the business was converted into a company.

A description of David Howard's chemical work, with its influence on commercial enterprise during a long and active life, is rendered possible by the methodical habit he had of keeping accurate note-books from the early time of his entering the works in 1864, in which he recorded his researches on points relating to chemical industry.

It was his habit when on his holidays to take with him these rough laboratory records, and at his leisure, in some quiet holiday resort, condense them into little separate treatises on the various points he had been studying during the past year. Away from business cares and distractions, he could devote the scientific side of his mind in moulding his ideas and inspirations into the certainty of ascertained facts, and form them into scientifically sound and commercially successful processes. Up to his last year he retained this power of accurate and careful recording of experimental work, and the note-book current at the time of his death is as neat, concise, and lucid, as the first in 1864.

Although the greatest part of his time in his laboratory was devoted to the systematic study of the cinchona alkaloids, he still undertook investigations on the production of many other pure chemicals, of which the purification of bismuth and its salts, the fractionation of ether, the extraction of benzoic acid from gum Benjamin, the purification of cinnamic acid (the subject of his first paper to the Chemical Society in 1861), iodides and iodoform, the production of valerianic acid, the extraction and separation of the morphia group of alkaloids from opium and the caffeine group from tea, may be taken as illustrating the wide range of his laboratory activity resulting in successful works processes.

On the cinchona alkaloids he was engaged for over forty years, evolving satisfactory analytical separations of the four principal alkaloids, and from his laboratory experiments perfecting the processes for the works.

He was a frequent visitor to Holland, often in communication with Léger, De Vrij, and Hesse, and for many years in close touch with the pioneers of the cinchona cultivation in Ceylon and India, for whom he did a large amount of analytical work, and to whom he was a constant adviser on the alkaloidal contents of their products. His life work on the cinchona group is epitomised in his last paper on "Cinchona Barks and their Cultivation," read before the Society of Chemical Industry in February, 1906.

Many as are the industrial concerns which have arisen and prospered in Great Britain during the last fifty years, there are few that can show such a continuous and solid growth as this business of which David Howard for so many years has been the presiding influence. His business, quite apart from the mere profit which it might bring, was a part of his life, and into the conduct of which Howard brought also that spirit of rectitude and of fair dealing which always characterised him.

Howard was elected a Fellow of the Chemical Society in 1869, and served on the Council for three separate periods, becoming a Vice-President in 1902. His mind being largely occupied with attention to matters connected with the business, Howard had little time for the writing and reading of papers. He contributed, however from time to time, the results of investigations carried out by himself or in conjunction with others, to the *Journal of the Chemical Society*, and other scientific journals.

From an early time David Howard took an intimate and active interest in the status of the professional chemist, and in the education of younger men about to enter that profession, or to embark in commercial work. He was ever anxious in support of a high standard of probity in regard to business dealings, and a desire that those proceeding to either mercantile or scientific occupations should have a thorough general training before entering on their advanced professional work. Such ideals gained for him esteem and regard not only among the chemical profession in which he held a high position, but also in commercial circles, as may be seen from his connection with the London Chamber of Commerce, in which he occupied the post of chairman of the Chemical Section for several years.

In the Institute of Chemistry, of which he was an original member, Honorary Treasurer for close on twenty years, and afterwards its President, David Howard took a special interest. This interest was a wide one, and was directed both to the educational as well as to the purely professional requirements of the Institute. He strongly supported the view that the object of the Institute should be to insure that its members received a thorough and systematic training on a liberal basis before proceeding to their final and special qualifications.

Arising probably from his own early training, he held decided views on the retention of a certain amount of Latin as a compulsory subject in the preliminary examination, a predilection which sometimes brought him into argumentative differences with some of his colleagues on the Council.

During his presidentship of the Institute, Howard, from his intimate association with commercial and manufacturing Chemistry, took great interest and gave much

assistance in the movement for the foundation of an advanced qualification which might be obtained by members who already possessed the Fellowship, and who were actually engaged in technical work. This scheme was established with the view of indicating the lines on which chemists in industrial work should prepare themselves, so as to more readily apply their knowledge to industrial problems.

In matters outside the educational objects of the Institute the experience gained by Howard as a magistrate and chairman of various other bodies was of great advantage. The knowledge he obtained from sitting on the Bench enabled him to form judgments on points connected with legal questions which have to be considered from time to time by such bodies as the Institute of Chemistry. This experience made him also valuable as a member to act on deputations of the Council, when required to interview Government or other Departments on matters of public interest.

David Howard was an original member of the Society of Chemical Industry, and from the date of his election had taken an active part in the proceedings of that Society, being at various periods on its Council and Committees, Chairman of the London Section, and finally President of the Society for the session 1886-87.

In 1907 he was elected an honorary member of the Society of Public Analysts and other Analytical Chemists.

As a manufacturer of pharmaceutical preparations Howard took an interest in pharmacy and the Pharmaceutical Society. This was not only a personal one, but was to some extent hereditary, as both his father Robert, and his uncle John Elliot, were intimately associated with that Society. A considerable number of his original communications appear in the *Pharmaceutical Journal*, and he himself never lost an opportunity when discussing the relations of chemistry and pharmacy to point out that the founders of modern chemistry were pharmacists.

Apart from his purely business life and his association with societies and institutions more particularly connected with his profession Howard's keen intellect ranged over wide regions of thought. He was interested in natural history and antiquarian lore, and possessed an intimate historical knowledge of the county of Essex, more especially of the districts round Epping Forest, where the most of his life had been spent and for which he had an intense affection.

In the eastern district of outer London David Howard held many public appointments and gave largely of his spare time in the assistance and advancement of local public questions. He was Deputy-Lieutenant for the county of Essex and Justice of the Peace for West Ham, seldom failing in a regular attendance on the Bench. He held also at various times the positions of Guardian of the poor and member of the Buckhurst Hill District Council, and his keen interest in educational matters made him a valuable member of the Walthamstow School Board, of which he was chairman.

David Howard was a man of strong religious feelings, which entered intimately into all the actions of his life. He gave generously, both of time and money, to the church and to many objects of charity in the district of Walthamstow. The memory of his kindly and unostentatious actions for the good of others, will ever remain in the hearts of the people among whom he lived.

To have known David Howard was to have known a man of no ordinary character. He was a man of strong personality, accompanied by great gentleness and simplicity of manner, and with a keen appreciation of humour. He had a strong sense of duty to his country and fellow-men, and took his place as a true citizen, both in local and national affairs. He was keen in business, distinctly a man of affairs, but at the same time full of intellectual interests. He was wise in council and a man of sound judgment. He had very strong opinions, which to those who did not know him intimately might savour of obstinacy. This, however, was not the case, for he gave every matter the most careful consideration before arriving at a conclusion, and having done so, felt strong enough to abide by it. Although a keen opponent in discussion, when finally convinced that the right might be on the other side he gave way with frankness and generosity.

A man of noble qualities, his death removes, not only from the domain of Applied Chemistry, but also from commercial and public life, one who can ill be spared.

JOHN M. THOMSON.



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

BRAZILIAN OILSEEDS.

BY E. RICHARDS BOLTON, F.I.C., AND DOROTHY G. HEWER, B.Sc.

(Read at the Meeting, December 6, 1916.)

INTRODUCTION.

THE question of the supply of fats and oils for edible purposes, as well as for soap, glycerol, and candle manufacture, has always been a matter of the utmost economic importance. The present European crisis renders it of national importance that no source of supply should be overlooked. Our lack of enterprise in this direction in the past is exemplified by the fact that various oleaginous seeds, though well known for many years, have only more or less recently been put to commercial use. It is an undisputed fact that there are vast quantities of oilseeds which have not yet been utilised to any extent, although many of them have been shown to yield considerable quantities of oil, often suitable for edible purposes, leaving non-fatty residues of value as cattle foods.

There are many reasons why some of these oleaginous seeds have not been better utilised in this country, quite apart from the fact that the foreign manufacturer, and the German in particular, has been ever more ready to crush a greater variety of different seeds than the British manufacturer, who has been content to keep to the same products year after year. This has been brought home to us so clearly of late that it is unnecessary to enter into particulars, but it may be worth while to

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consider briefly some of the less apparent reasons why new oilseeds have been so sadly neglected.

From time to time small consignments of 20 to 100 tons are sent over to "feel" the market, and samples are offered all round to different manufacturers. The manufacturer, feeling that there is no competition for a product concerning which little is known, usually offers a price very considerably below the true market value, and in so doing virtually defeats his own ends, in that he gives the importer the impression that that particular product is not likely to prove a profitable export, and so it becomes neglected until its value is realised by some enterprising foreigner.

Further, another very important point in connection with these small consignments is that, in order to crush any new or different type of seed, the manufacturer must cleanse his entire plant from the product with which he has been previously working, an operation which would not be worth his while for a small consignment. For this reason small parcels of even well-known oilseeds are less easily marketable than larger ones.

Oil has been produced commercially from quite a number of the seeds here mentioned, and the oils, more especially those from the various palms, are finding their way into manufactured products. It therefore behoves the analyst to exercise the greatest care in identifying any special oil, and we trust that the figures given below will be a guide in this difficult problem.

The authors have examined, in the past, a very large variety of oilseeds, many of which are likely to become of commercial importance in the future, while some of them have already been used on a large scale; for example, upwards of 6,000 tons of Babassu kernels have been exported from Brazil during the past two years.

Brazil offers a specially large variety of oil-bearing products, and of these the twenty specimens dealt with in this paper have been selected as typical.

The foregoing remarks may at first sight appear to deal with considerations beyond the scope of the analyst, but the authors are of the opinion that the analyst cannot advise his clients to the best advantage unless he surveys the commercial aspect when interpreting the results of his analysis.

Our thanks are due to Messrs. Booth and Company (London), Limited, for most of the specimens examined and for data as to the districts of origin, and to Mr. J. Masters Hillier, of the Royal Botanic Gardens, Kew, who has kindly identified some of the specimens botanically.

VARIOUS PALMS. (SEE PLATE I.)

Of the many oleaginous seeds found in Brazil, particularly up the Amazon, those of the palms are, in general, the most useful, and deserve special attention for the following reasons :

- (a) The kernels of those described all yield oil which can be refined for edible purposes, such as margarine manufacture.
- (b) The kernels leave a non-fatty residue suitable for cattle-feeding.
- (c) The kernels have a high content of oil, are easily shipped, and do not readily decompose in transit.

(d) In the case of many of the palms quite a high percentage of oil is found in the pulp surrounding the shell which encloses the kernel, and the pulp oil, though not usually adaptable to edible purposes, finds many other uses—for example, in soap manufacture.

(e) The similarity of the oils obtained from the kernels of the various palms enables the manufacturer to mix the oils.

There are, however, some disadvantages in the use of these oils, and these are mainly:

(1) The kernels are always enclosed in a more or less hard shell, which in two or three cases would have to be cracked by special machinery.

(2) The wide area of distribution causes difficulties in collection as well as in the choice of centres for shell removal and treatment of pulp, but the possibility of mixing some of the kernels is, to a certain extent, helpful in this connection.

All those palms whose fruits are surrounded by an oily pericarp would have to be de-pericarped in the country of origin. This is necessary on account of the delicate nature of the pericarp and the presence of the weighty shell surrounding the kernel.

1-3. *Elæis Guineensis*. Nat. Order, *Palmae*; Tribe, *Cocoinæ*.

The African oil palm is perhaps the best-known oil-bearing palm in the world, and its fruits need no description. This palm is also to be found in Brazil, where it yields a fruit indistinguishable in appearance and structure from that of the tree which grows in Africa; but climatic soil and other conditions have caused the fruits to contain not only less fatty matter, but fatty matter of a distinctly different constitution to that of the same palm when found in Africa. On the Amazon it is known under the name *Caioué*, and flourishes largely in Pará, Manáos, and the Amazon valley generally.

In the table of figures data are given for two specimens, and average figures for the African variety are cited for comparison.

The following table shows the proportion of pulp and kernel as compared with those of the African variety:

	Brazil.		Africa.
	Manáos.	Amazon.	
Epicarp + mesocarp (pulp)	26	17	38
Endocarp (shell)	58	58	47
Kernel	16	25	15
	<hr/> 100	<hr/> 100	<hr/> 100

Both the pulp oil and the kernel oil are suitable for the same purposes as the palm oil and palm kernel oil of commerce, though the constants given by these oils are sufficiently different from those of the African product to call for special attention, and render it unwise to deliver the Brazilian oils in fulfilment of a contract for the African products. The buyer might take advantage of the different constants to put forward a grievance, though in the opinion of the authors the Brazilian kernel oil is inclined to be of greater value than the African, the African pulp oil (palm oil), on the other hand, being more commercially serviceable.

Lewkowitsch ("Oils, Fats, and Waxes," vol. ii., p. 533) refers to a species of palm, *Enocarpus melanococca*, Gart., as cultivated in Brazil, and from which the quantities of oil obtained are small. This palm should not be confused with the palm here dealt with, which appears to have owed its origin in Brazil to the planting of the seeds of *Elæis guineensis* by African settlers.

4. *Astrocaryum Vulgare*, Mart. Nat. Order, *Palmæ*; Tribe, *Cocoinææ*. The *Tucum* or *Aouara Palm*. Found in Maranhã, Pará, and in the Amazon valley, where it grows to a height of 30 to 50 feet.

Only small consignments, amounting to some 600 tons of the kernels, have hitherto been exported. The fruit bears a distinct relationship to that of the African oil palm, and consists of—

Outer Pulp	..	..	..	..	..	..	..	..	..	34
Shell	..	..	..	..	..	..	..	..	..	46
Kernel	..	..	..	..	..	..	..	..	..	20

Pulp Oil.—At normal temperatures this oil has a consistency like vaseline, but is slightly more granular, and is of a pale straw colour, with a faint and not unpleasant smell. The solidity of the oil is chiefly due to free fatty acids, as the neutral oil is almost liquid. It is suitable for soap manufacture, and if prepared from fresh fruits, so that the free fatty acids do not exceed 10 per cent., it could be refined for edible purposes—viz., margarine. Its value is slightly below that of palm oil.

Kernel Oil.—This is a solid, firm, and somewhat brittle, creamy-white fat, having a smell and appearance like the well-known palm kernel oil of commerce, which it closely resembles in properties. It is suitable for the same purposes as palm kernel oil, and makes an excellent edible oil when refined. Owing to its higher melting-point and larger content of "stearine," its commercial value should be greater than that of palm kernel oil.

5. *Astrocaryum Species*. Nat. Order, *Palmæ*; Tribe, *Cocoinææ*. Known as *Murumurú*. Found in Pará.

The fruit consists of a thin, hard, black woody shell sparsely covered with fibre, and loosely enclosing a cone-shaped kernel of similar texture to a palm kernel.

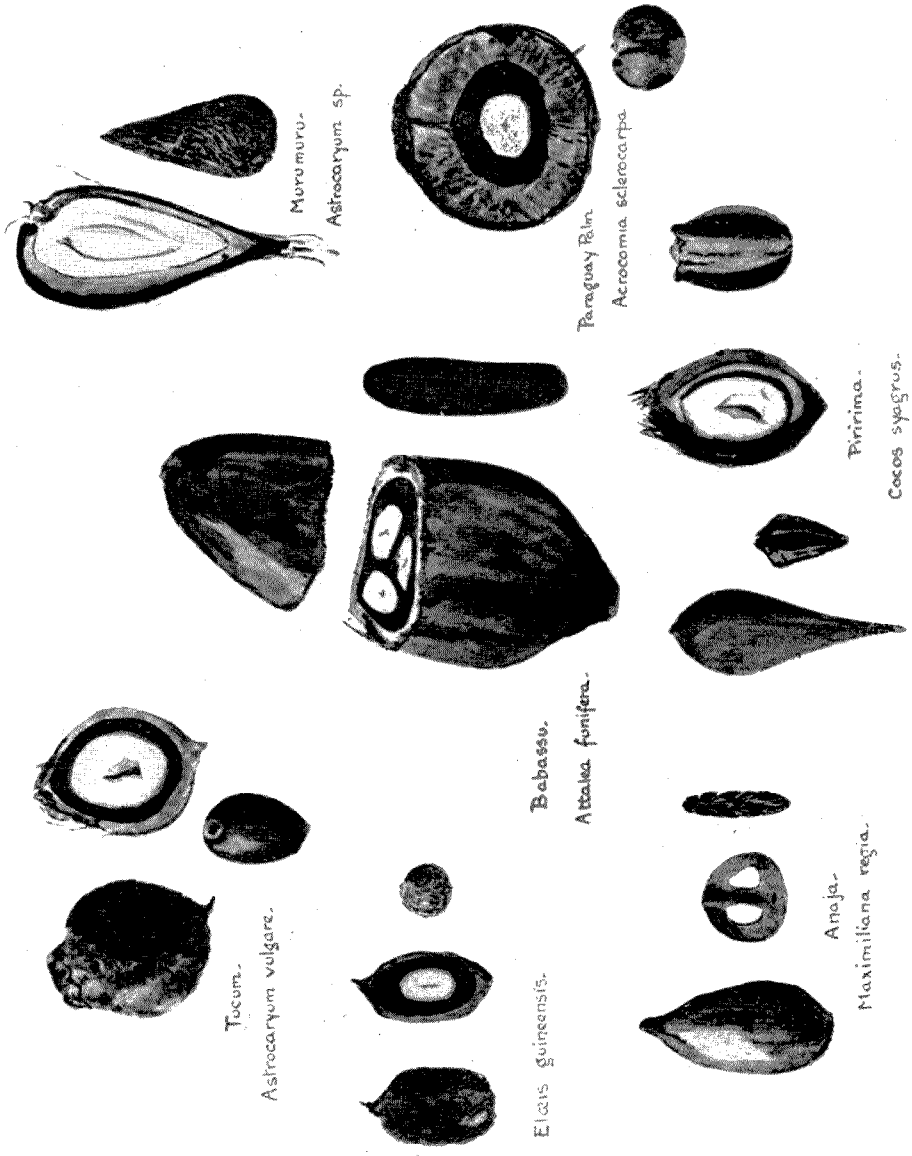
The oil obtained from the kernels is hard, white, brittle and solid, with little taste or smell. The hard and brittle consistency of the fat is of some importance, in that it provides a natural product closely resembling coconut "stearine," which is made by pressing coconut oil by a somewhat expensive process. It will therefore be suitable as a cocoa-butter substitute, and for other purposes for which coconut "stearine" is used.

The value of the oil for edible purposes is so great as to render it unlikely that much would be left for other purposes, for which, however, it is obviously suitable.

6. *Acrocomia Sclerocarpa*, Mart. Nat. Order, *Palmæ*; Tribe, *Cocoinææ*. The *Paraguay Palm*.

The tree grows to a height of 20 to 30 feet in Bahia, and forms large forests in Paraguay. The fruits are of a somewhat similar structure to Tucum fruits, but the

I. PALMS.



See page 36.

outer pulp is enclosed in a thick, smooth shell. The proportion of the parts is as follows:

Outer shell (epicarp)	..	..	..	..	..	..	..	28
Mesocarp	{	Oily pulp	..	..	..	..	..	24
		Inner shell (endocarp)	..	..	..	..	..	42
Kernel	..	..	..	..	..	..	..	6
								100

Pulp Oil.—This oil is analogous to commercial palm oil, has a somewhat similar smell and consistency, and is of a golden-yellow colour. The oil is suitable for soap manufacture, and if obtained from fresh fruits, so that there is not more than 10 per cent. of free fatty acids, it could be refined for margarine-making. Its value is slightly below that of palm oil.

Kernel Oil.—This oil is of a similar nature to palm kernel oil, but of a much softer consistency. All the samples examined were free from any very pronounced smell, and were of a pure white to a pale creamy colour. The comparatively low melting-point of the oil renders it of less value than commercial palm kernel oil, but the high content of oil in the kernel makes up for this deficiency, and brings the value of the kernels above that of African palm kernels. The refined oil is specially suitable for margarine-making, while the crude oil would serve for soap manufacture.

The exceptionally high content of protein in the non-fatty residue has been recorded by Bray and Elliott (ANALYST, 1916, 41, 298).

7. *Maximiliana Regia*, Mart. (*M. martiana*). Nat. Order, *Palmeæ*; Tribe, *Cocoinææ*.

The *Anajá*, or *Kokerite Palm*. Found in Ceará and Pará valley.

The specimens, as received, consisted of a hard, woody, oval-shaped shell, pointed at one end, in which are loosely embedded one to three kernels, but more usually only two. The kernels amount to 12½ per cent. by weight of the nut.

The nuts are identical in appearance and description to those referred to by Bray and Elliott (*ibid.*), but the authors' figures, though indicating the fat to be of a similar type, are not otherwise in agreement.

The kernel oil is a firm white solid of lard-like consistency, but exhibiting a tendency towards brittleness. It is practically odourless, and is very similar to African palm kernel oil, being suitable for the same purposes, more particularly as an edible fat.

8. *Cocos Syagrus*. Nat. Order, *Palmeæ*; Tribe, *Cocoinææ*. Known as *Piririma*.

Found in the Pará valley.

Two distinct types have been examined, the more common being a blunt form, which consists of a hard shell sparsely covered with fibre, enclosing a tough white kernel covered by a brown, woody skin. The pointed kernels are similar in every way except shape. The structure of both the long and blunt kernels is strikingly characteristic in that they have three points of attachment, close together in the former, and widely apart in the latter.

Although the proportion of oil in the two types is very different (the blunt

TABLE I. (Illustrations on Plate I.: Palms.)

	ELÆIS GUINEENSIS.		ASTROCARYUM VULGARE.	ASTROCARYUM SP.	ACROCOMIA SCLEROCARPA.	MAXIMILIANA REGIA.	COCOS SYAGRUS.	ATTALEA FUNIFERA.	ENOCARPUS BATAVA.
	(1)	(2)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Native Names:	<i>Caitané from Manicos.</i>	<i>Caitané from Amazon.</i>	<i>Tucum Aouara Palm.</i>	<i>Murumurá.</i>	* <i>Paraguay Palm (Grou-grou, Macassaba, Kawmakka, Mactio, Mocayo).</i>	<i>Anajá Coke-Blant Pointed fruits.</i>	<i>Piririma Blant Pointed fruits.</i>	<i>Bobassá, Bassoba, Curúa, Ucau-assú † Cequilla, and Cequito.</i>	<i>Pataú (Coanou, Batava or Bacaba).</i>
Weight of 100 seeds in grams ..	fruits 650	fruits 320	fruits 1,900	fruits 1,250	fruits 3,300	nuts 738	1,100	fruits 11,000	
Percentage of kernel ..	16.7	25	20	46	6	12.5	40	41	—
Oil content per cent. {	34.7	36.7	43.5-52.5	38.46-40.2	Grou-grou. Paraguay. 53.4-64.8	60.15	32.1	23.0	65-68
Kernel ..	46.9	19.7	37.5	negligible	63.7	—	—	—	—
Whole fruit or seed ..	17.7	12.5	21.4	17.9	18.7	—	—	—	—
Analyt. figures for oil from {	Pulp. Kernel.	Pulp. Kernel.	Pulp. Kernel.	Kernel.	Kernel.	Kernel. Kernel.	Kernel. Kernel.	Kernel.	Pulp Oil.
Incipient fusion ..	22	28.5	27.0	33	—	26	23	22.2	—
Complete fusion ..	30	30.2	35.0	34	—	28.5	29	26.1	—
Solidifying-point, °C. ..	21.9	27.3	—	32.5	24.9	19.4-24.9	26.8	22.7	7.0
Saponification value ..	197.1	231.4	220.2	237.0	189.8	240.9	252.2	246.9	191.8
Refractive index at 40° C. ..	48.5	46.5	51.5	36.8	40.5	38.3	37.4	37.1	52.5
Iodine value ..	78.1	25.5	88.3	12.4	77.2	16.56	12.5	16.3	78.2
Free fatty acids as lauric in kernel oil and oleic in pulp oil ..	29.8	6.55	20.5	0.36	55.8	0.4	3.2	2.97	0.48
Unsaturation matter ..	—	—	0.75	—	—	—	—	—	1.1

* Bray and Elliott (*ibid.*) suggest a difference between Grou-grou and Paraguay kernels, which is confirmed by the authors, who find higher iodine values and lower saponification values for the oil from the latter.

† Means Little Coconut, and is also applied to the Coghane and other nuts.

TABLE II. (Illustrations on Plate II.: Various Oilseeds.)

	VIROLA BICUHYBA.	MYRISTICA PLATYSPERMA.	PENTACLETHRA FILAMENTOSA.	PENTACLETHRA MACROPHYLLA.	CARYOCAR SP.	PACHIRA SP.	CARAPA GULANENSIS.	OMPHALEA MEGACARPATA.
Native Names:	(11) <i>Ucuhuba.</i>	(12)	(13) <i>Parou-cary.</i>	(14) <i>Maboula Panza, Attawa, Atta beans, Odu, Fai Fulla Panza, Opochada, Nallu Panza.</i>	(15) <i>Sacha Almen-dras, Savarri or Suari Nuts, Pekoa Nuts.</i>	(17) <i>Mamurana, Manguba.</i>	(19) <i>Andiroba, Toudou-couva, Crab Carapa.</i>	(20) <i>Cuyeté, Comuadre de Azcité.</i>
Weight of 100 seeds in grams	131	435	79	700-1,800	1,855	—	1,800	1,980
Percentage of kernel ..	82	72	51	90	23	82	74	76
Oil content { Kernel ..	69.4	50.99	62.27	58.03	70.39	58.03	57.85	66.75
in { Whole seed	57.8	36.0	31.7	47.6	16.2	—	42.7	50.7
<i>Analytical figures for oil.</i>								
Melting point, °C. { Incipient fusion	41.7	41.0	—	—	30.5	18-31	—	—
{ Complete fusion	43.3	42.5	18.4	18.4	37.0	40	28.0*	liquid
Solidifying point, °C. ..	40.0	39.8	14.0	14.4	28.6	—	—	—
Saponification value ..	229.3	239.5	177.0	181.3	197.6	206.7	197.0	192.2
Refractive index Zeiss at 40° C.	50.9	37.1	52.8	57.8	46.2	47.2	50.0	58.4
Iodine value	14.1	4.98	68.96	100.4	41.86	41.7	62.2	115.8
Free fatty acids as oleic	17.5	3.72	0.20	0.08	0.10	8.7	18.6	0.10
Unsaponifiable matter ..	3.2	—	—	1.37	—	—	4.0	0.49
Specific gravity at 15° C.	—	—	—	0.917	—	—	—	0.9218

* Portion liquid at 15° C.

containing the greater quantity), in their nature the two are practically identical, and it is curious to note that the authors' analytical figures bear a striking resemblance to those given by Bray and Elliott for *Maximiliana regia*, though clearly the nuts are not the same. The oil is suitable for the same purposes as Anajá oil.

9. *Attalea Funifera*, Mart. Nat. Order, *Palmæ*; Tribe, *Cocoinæ*. Known as *Babassú*.

This palm is very plentiful in the vast territory between lat. 3° to 10° south, and long. 40° to 70° west (Greenwich).

The fruit consists of one to four, but more usually only three, long, narrow kernels, enclosed in a hard woody shell surrounded by a fibrous pulp. This pulp only contains about 1 per cent. oil. The fruit may be regarded as one of the most difficult to crack, and yet, as mentioned before, 6,000 tons of kernels have been exported in two years, a considerable proportion of which reached this country.

The oil closely resembles coconut oil, and, although of similar melting-point, the higher proportion of unsaturated glycerides cause it to be of a somewhat softer consistency; it is nevertheless an excellent margarine oil.

10. *Ænocarpus Batava*. Nat. Order, *Palmæ*; Tribe, *Areceæ*. Known as *Pataúá*. Found in Pará and Maranham.

The oil is prepared by the natives from the pulp, and the specimens of depericarped seeds examined by the authors were found only to contain mere traces of oil. The native prepared oil varies from a pale green to a yellowish-green colour, and is almost odourless and tasteless. All the samples examined were found to be very low in acidity. The oil bears a striking resemblance to olive oil, and, save for a distinctly lower refractive index and a hardly appreciably lower iodine value, the analytical constants are strikingly similar, including its specific gravity of 0.9158. When subjected to Bellier's test, as modified by Evers (*ANALYST*, 1912, **37**, 488), it behaves in a similar way to olive oil.

Methods of rapidly distinguishing this oil from olive oil are specially needed in view of the fact that it is eminently suitable as a salad oil, and would prove an excellent edible oil generally.

SEEDS AND FRUITS OTHER THAN PALMS. (SEE PLATE II.)

11. *Virola Bicuhyba*, Humb. Nat. Order, *Myristicaceæ*. Known as *Ucuhuba*. From Pará and Madeira River.

The seeds alone seem to be indistinguishable either by appearance or analysis from those of *Virola venezuelensis*, Warb., known under the name "Cuajo," and equally so from those of *Myristicia surinamensis*, though the seeds of *M. guatemalensis* ("Fatty Foods," p. 272) usually have a lower content of fat, which gives slightly different constants.

Owing to the large variety of *Myristicia* species, there is some confusion due to the overlapping of the botanical names given to the same member by different botanists, and the line of demarcation is neither botanically nor analytically clear. *M. mala-*

barica, however, may be distinguished by its long-shaped seeds, while *M. canarica*, also found in Brazil, usually has a high content of resinous matter which is difficult to separate from the oil.

All the above-named seeds have a more or less pronounced arillus, which contains an essential oil, producing a characteristic smell. In the case of Uchuba seeds the proportion of ethereal oil is very small, and the fatty matter, if not too acid, may be refined to an almost odourless and neutral state, and a valuable fat thereby obtained. Acid and decomposed fats provide an excellent candle material on distillation.

12. Myristica Platysperma, Spruce. Nat. Order, *Myristicaceæ*.

A sample of the de-pericarp seed was received from Manáos under the erroneous name of "rubber seed." The appearance of the seed and the analytical constants prove it to be the same as the seed described by Jesson (*Misc. Information, Kew*, No. 9, 1914, p. 333) as a native of North-West Brazil.

The seed has the characteristic structure of the *Myristicaceæ*—that is to say, when cut in section it shows the peculiar integumental ramifications of the inner seed coat into the endosperm, giving an appearance resembling marble.

The seed is made up of—

Kernel (endosperm and spermoderm)	55
Shell	45

The fat is of a pale creamy-white colour, and very hard and brittle in nature, and appears to consist chiefly of myristin.

A fat of this description has many commercial uses and would command a high price.

13. Pentaclethra Filamentosa. Nat. Order, *Leguminosæ*; Sub-Order, *Mimoseæ*.
Known as *Paroa-caxy*. From Pará.

The seeds or beans are disc-shaped and pointed at the end of attachment. They consist of a hard, thin, shiny brown shell, enclosing a soft oily kernel. The oil is of a pale golden colour with a slight "nutty" taste and smell. At normal temperatures the oil is liquid, but if maintained at 20° to 21° C. a definite separation of "stearine" takes place. The low acidity of the oil from this type of bean (see also *Maboula panza*) is very striking. There is good reason to suppose that the oil would prove suitable for edible purposes if refined. *Pentaclethra* oils are characterised by a high titer, and are free from any unusual quantity of unsaponifiable matter; but, although they saponify fairly readily, they yield rather soft and poor-coloured soaps.

The non-fatty portion of the kernel is very rich in protein, and is probably edible.

14. Pentaclethra Macrophylla, Benth. Nat. Order, *Leguminosæ*; Sub-Order, *Mimoseæ*. Known as *Maboula panza*. Common in East and West Africa, but not so common in Brazil.

The plant is closely related to *P. filamentosa*, and the seeds are known under a great variety of names (see Table II.), but more generally as *Maboula panza* beans.

The oil may be described as practically identical in properties to those of *P. filamentosa* oil, and behaves in a similar manner on saponification. It has a titer of 53° C.

The beans are said to be edible, and, according to the Official Guide to No. 1 Museum, Kew, they are often mixed with the seeds of the wild mango (*Irvingia Barteri*) to make the well-known Dika bread.

15. Caryocar Species, probably *C. amygdaliferum* or *C. brasiliense*. Nat. Order, *Ternstroemiaceæ* (Tea Order). Known as *Sacha Almendras*. From Iquitos, Peru.

The seeds consist of a brown shell, smooth and shiny inside and raised into irregular protuberances all over the outside. This encloses an oily kernel, white in colour and covered with a thin brown skin. The kernels are edible, and are described by Bentley as "probably the most agreeable of all the nut kind."

The fat, which is a firm, brittle solid, is snow-white in colour, practically odourless, and with a very pleasant taste. It is an edible fat *par excellence*, but, owing to the fact that it does not "mould" well, is unsuitable alone as a cocoa butter substitute; but if mixed with softer fats the difficulty might be overcome. Needless to say, it would serve, in admixture with suitable oils, as a margarine fat, lard substitute, or baking fat.

16. Marins, from Maranham and Pará.

Many attempts have been made to trace the botanical origin of these seeds, but without success.

The seeds consist of a thin canary-coloured outer shell enclosing a soft yellow, oily kernel. The oil, which is liquid at ordinary temperatures, is of a deep golden-yellow colour, and is almost as viscous as a "blown" oil. The oil might serve as a lubricant if mixed with 4 or 5 volumes of mineral oil, but experiments in this direction are needed.

17. Pachira Species. Mamurana, from Pará.

A number of specimens have been received from time to time, most of them consisting of kernels only, while some included a thin, brittle outer shell. The kernels which were always received in a very dirty condition are irregular in shape, smelling like a mixture of liquorice and fenugreek. The oil, which is solid at normal temperature, is of a very soft, oily nature, though the solid portion does not melt under 40° C. The smell of liquorice is tenaciously retained by the oil, but this does not prevent its utilisation for soap-making.

It is possible, in the event of the non-fatty portion proving edible, that it might be relished by cattle in the same way as fenugreek, which has the same sort of smell.

18. Mahuba-rana.

These seeds have not been botanically recognised.

The fat bears a great resemblance to that of members of the *Myristicaceæ* (11 and 12), but the structure of the kernel does not point to any relationship with that Order.

The fat obtained was very dark coloured, which may have been partly due to the condition of the specimens. The dark colour on saponification detracts from the value of the oil for soap-making. The high content of hard fatty acids suggests its use as a candle material.

19. Carapa Guianensis, Aubl. Nat. Order, *Meliaceae*. Known as *Andiroba*. From Pará and North Brazil generally.

There appears to be some confusion in botanical literature on *Carapa* seeds, but it would appear that the names *C. guianensis* and *C. procera* are synonymous. Lewkowitsch (ANALYST, 1908, 33, 184, and 1909, 34, 10). in dealing with *C. guianensis* (*C. procera*), refers to the difficulty in correctly identifying the several specimens, and although the analytical figures given here bear a distinct relationship to those obtained by Lewkowitsch, a clear line of demarcation is still wanting. The confusion is still further added to by the fact that the authors have found several specimens of *Andiroba* oil to be optically active— $(\alpha)_D$ in 100 mm. to 0.7 ang. deg.—whereas Lewkowitsch (*ibid.*) regards the oil of *C. procera* as not containing optically active substances, in contradistinction to the oil of *C. grandiflora*.

Andiroba oil is prepared by the natives, and a residual paste is offered for sale. Both paste and oil are very bitter and have anthelmintic properties, so that the oil cannot be used for edible purposes, nor would the cake serve for cattle-feeding. The oil is suitable for soap-making.

The following figures for the oil have been obtained in addition to those given in Table II.:

Reichert-Meissl value	..	..	..	..	..	..	..	..	2.5
Polenske value	..	..	..	..	..	..	..	..	0.3
Kirschner value	..	..	..	..	..	..	..	..	2.1
Titer	..	..	..	..	..	..	..	..	36.2° C.

20. Omphalea Megacarpa, Hemel. Nat. Order, *Euphorbiaceae*. Cayeté* nut of Manáos and Pará.

The seeds consist of an inner yellow oily kernel, which is coated with a pith-like skin, the whole being loosely enclosed in a fairly thin, grey-brown, friable shell.

The oil is liquid at ordinary temperatures, of a pale straw colour, without any very pronounced taste, and with a slight but not unpleasant odour. According to Professor Cash (see Imp. Inst. Col. Rpt., No. 88, p. 473)—

“The oil probably increases peristalsis by stimulating the intramural nervous plexuses of the intestine. It also produces diuresis, owing presumably to a stimulation of the kidney tissues, but the exact mode of action is not yet determined. The dose of the oil is about 4 grams. The oily nature of the material, apart from the purgative principle, is considered to add slightly to the purgative effect by exerting a feeble mechanical action. The oil is regarded as a valuable non-irritant cathartic, and its activity does not decrease appreciably with age. The dose required is much smaller than that of castor oil, and the taste is not unpleasant.”

The physiological properties are said to be inherent in the oil itself, and not due to traces of impurity.

The oil might find an outlet as a substitute for castor oil, as it has a more pleasant taste, and it can easily be distinguished from castor oil as follows:

- (a) It has widely different analytical constants.
- (b) It is not optically active.
- (c) It is not very viscous.
- (d) It is only slightly soluble in alcohol.

* Cayeté is the name of an Indian tribe.

ABSTRACTS OF PAPERS PUBLISHED IN OTHER JOURNALS.

FOOD AND DRUGS ANALYSIS.

Accurate Aeration Method for the Estimation of Alcohol in Fermentation Mixtures. A. W. Dox and A. R. Lamb. (*J. Amer. Chem. Soc.*, 1916, **38**, 2561-2568.)—The estimation of ethyl alcohol by oxidation with sulphuric acid and dichromate solution, followed by titration of the acetic acid produced as originally described by Dupré (*J. Chem. Soc.*, 1867, **20**, 495), was carefully studied. It was found unnecessary to reduce the excess of dichromate with zinc before distillation, and the oxidation of the alcohol proceeds quite readily by merely allowing the mixture to stand in the distilling flask for a few minutes before distillation. The preliminary separation of the alcohol solution for oxidation from the medium containing it within a reasonably small volume is tedious and troublesome, even when it is distilled from a saturated salt solution, and is often far from quantitative. It is recommended as an improvement that the alcohol solution should be saturated with ammonium sulphate and the alcohol carried over into concentrated sulphuric acid, which absorbs it readily, by a current of air passing for about eight to ten hours at room temperature. The alcohol-sulphuric acid solution may then be mixed with a solution of potassium dichromate, and the acetic acid distilled off at once. Results accurate within 1.5 per cent. of the amount used were obtained by this method. Acetone distils practically unoxidised, and methyl alcohol is converted entirely to carbon dioxide and water. Acetaldehyde or ethyl acetate, if present, give acetic acid and must be allowed for; toluene and pyridine are unaffected.

H. F. E. H.

Coconut Toddy in Ceylon. K. C. Browning and C. T. Symons. (*J. Soc. Chem. Ind.*, 1916, **35**, 1138-1142.)—The authors give a full account of the preparation of toddy (palm juice) as drawn from the coconut palm (*Cocos nucifera*) in Ceylon, and describe the methods of collecting the juice and obtaining sugar, the fermented toddy, arrack, and vinegar from it. With one tapping a day the yield varies from 600 to 1,200 c.c. per tree; with two and three tappings the yield may rise to over 3,000 c.c. The best yields are got when the weather is neither very wet nor very dry, trees near the sea yielding better than those farther inland. The juice is drawn from the unopened flower spathe, which is bruised a considerable time before the actual incision for collecting purposes is made. For use as a sugar basis the toddy must be drawn unfermented, the inhibition of fermentation being obtained under official regulation by placing a small amount of slaked lime in the collecting pots each day. If drawn into a clean and new vessel, no natural fermentation ensues; but if the vessel is that ordinarily employed and containing adhering yeasts and bacteria, fermentation starts at once. The actual process of manufacture of the crude sugar or "jaggery" is very primitive, and consists of straining off the juice containing lime and boiling down to a thick syrup, after which it is allowed to solidify to a

deliquescent solid in coconut shells. One gallon of toddy yields about $1\frac{1}{2}$ pounds of jaggery, which has now ceased to be exported, and is used locally as a substitute for imported sugar and as a sweetmeat.

When collected in unlined vessels, fermentation at once ensues, and the liquid is drunk as a somewhat turbid but strongly sparkling and refreshing beverage, with a smell which to a European is unpleasant. It rapidly sours, and after twenty-four hours is too acid to drink.

When distilled in primitive copper stills it furnishes arrack, a very crude and impure spirit of low quality seriously contaminated with copper. Since it is kept several days before distilling, the yield is very poor and a high acidity develops. The total amount of arrack distilled in Ceylon is about $1\frac{1}{2}$ million gallons per annum of 25° under proof. For the production of vinegar, toddy is allowed to become sour, and is then stored in open vats for long periods mixed with various herbs. The acidity may rise to as much as 6 per cent. reckoned as acetic acid. A typical analysis of the unfermented juice collected in a sterile vessel is as follows:

Sp. gr. 1.063 (at 80° F.), conductivity (K) estimated on an Evershed and Vignoles dionic water tester, 4,500; refractive index R. 30° C., 71.8; total solids, 16.22 grms. per 100 c.c.; ash, 0.185 per cent.; cane-sugar, 12.3 per cent. (Hilger polarimeter, solution cleared with solid basic lead acetate separated with potassium oxalate); proteins, 0.29 per cent. A fermented toddy had the following composition: Sp. gr. 1.005 (at 85° F.) K=5,000; total solids, 3.36 per cent.; ash, 0.23 per cent.; acidity (as acetic acid), 0.32 per cent.; alcohol per cent. by weight, 4.9. The percentage of alcohol in fermented toddy varies extremely owing to the crude fermentation methods employed; thus, in one distillery 92 samples taken throughout the year varied from 8.8 to 2.6 per cent. by weight, the average being about 4 per cent. No sugars other than cane-sugar, dextrose, and lævulose have so far been detected in the juice, the average percentage of sugar in the unfermented juice being about 17 per cent.; but, owing to bad methods, only about half this is actually obtained. The following organisms have been isolated from toddy: (1) Typical *S. cerevisiæ* (top fermentation); (2) a wild yeast resembling *S. ellipsoideus*; (3) schizo-saccharomyces; (4) zygo-saccharomyces resembling *Z. Barkeri*; (5) a yeast resembling *S. Ludwigii*. No film-forming yeasts, *mycoderma*, or *torulæ* were found. Moulds resembling *Monilia* and *Oidium* and many bacteria were also present.

H. F. E. H.

Delicate Test for Dimethylaminophenyldimethylisopyrazolone (Pyramidone). L. Guglielmelli. (*Anal. Soc. Quim. Argentina*, 1916, 4, 180-182; through *J. Chem. Soc.*, 1916, 110, ii., 587-588.)—Arsenotungstic acid gives with dimethylaminophenyldimethylisopyrazolone a white precipitate soluble in alkali with production of an intense blue coloration. Arsenotungstomolybdic acid gives a white precipitate, soluble in alkali to an indigo-blue solution. Both nitric acid and ferric chloride gave an indigo-blue coloration.

Estimation of Fat in Cacao Powder. Keller. (*Apoth. Zeit.*, 1916, 31, 330.)—There is no advantage in mixing the cacao powder with sand before extracting the

fat with ether; moreover, the admixture with sand prevents the use of the extracted powder for the estimation of the crude fibre. The cacao powder should be extracted in a Soxhlet apparatus for sixteen hours in order to obtain the whole of the fat. Theobromine is extracted together with the fat, and forms a white deposit on the wall of the extraction flask; in most cases this small quantity of theobromine may be ignored, but, if desired, the fat, after being weighed, may be dissolved in ether, the flask rinsed with this solvent, and then reweighed with the deposit of theobromine. Besides theobromine, the ethereal extract of cacao contains another basic substance which yields a gold salt having a melting-point and gold percentage different to those of bromine gold chloride.

W. P. S.

Sensitive Reaction for Apomorphine. L. P. J. Palet. (*Ann. Soc. Chim. Argentina*, 1916, 4, 83-86; through *J. Chem. Soc.*, 1916, 110, ii., 587.)—With Guglielmelli's arsenotungstic or arsenotungstomolybdic reagent, apomorphine gives an indigo-blue coloration; the coloured substance dissolves in amyl alcohol to a solution of the same colour, and in benzene to an intense violet solution.

Microchemical Distinction of Morphine from Codeine. O. Tunmann. (*Apoth. Zeit.*, 1916, 31, 148-150; through *J. Chem. Soc.*, 1916, 110, ii., 655-656.)—When treated with hydriodic acid, morphine and codeine yield crystals which have always the same forms and allow of the differentiation of the two bases. A little of a salt of the base is sublimed by heating on an asbestos plate, and the sublimate covered with a cover-glass, at the edge of which a drop of hydriodic acid is then introduced. A slight granular precipitate is thus formed, and this disappears on heating. When the preparation is cooled, crystals of the tetra-iodide are formed immediately in the case of morphine, whereas with codeine crystals of the tri-iodide are formed only after three to five minutes, but more rapidly in presence of a small drop of alcohol. The morphine tetra-iodide crystals are always very flat, quadrangular, mostly rectangular plates, on the average 30 to 50 μ broad by 80 to 120 μ long, and are of prismatic character and show direct extinction and a blood-red to brownish-red colour. The bulk of the crystals are united to ladder- and step-like aggregates more than 1 mm. in length, and these in their turn are combined to stars and crosses. Pleochroism is either very slight or non-existent. Codeine tri-iodide crystals are paler, thicker, and smaller, the aggregates being not more than one-third of the size of morphine tetra-iodide crystals. Single crystals (20 to 50 μ \times 40 to 80 μ) are very rare, and form half-moon-like triangles with a concave base and a blunted apex. The majority are twinned crystals, which always grow out on the convex side and give butterfly- and goblet-like forms, by which these crystals are recognisable at the first glance. Strong pleochroism is observed in this case.

Chemical Composition, Digestibility, and Feeding Value of Vegetable Ivory Meal. C. L. Beals and J. B. Lindsey. (*J. of Agric. Research*, 1916, 7, 301-320.)—Vegetable ivory, or the corozo nut, is the seed or nut of the palm-like plant *Phytelephas macrocarpa*, found in South America. Thousands of tons are exported annually for the manufacture of buttons, etc., and the turnings, chips,

etc., have been employed when mixed with other ingredients as a cattle food and as an adulterant of concentrated feeds. Analyses show that it contains about 5 per cent. of protein and 75 per cent. of nitrogen-free extract; fat and ash are negligible in amount, while crude fibre averages 7 per cent., and pentosans 2.5 per cent. Lignin, galactan, starch, and dextran are absent, while 91.5 per cent. of the nitrogen-free extract consists of mannan, an anhydride polymer of mannose. A non-nitrogenous alcoholic precipitate can be obtained from a boiling aqueous extract of the meal amounting to about 2.5 per cent. on the sample, which is not pentose in nature and differs from fruit "pectin" in not forming mucic acid and not reducing Fehling's solution. By the use of Fehling's solution about 0.5 per cent. of water-soluble reducing material and 2 per cent. of total sugars are shown to be present after inversion with hydrochloric acid in the cold.

The mannan is not entirely hydrolysed short of at least four and a half hours, boiling in an acid solution. The calorie value of the meal ranks well with other carbohydrate foods, and it possesses a fuel value equal to one-half that of soft coal. Sheep eat it readily when mixed with other grains, and digest it thoroughly. Eighty-four per cent. of the dry matter and 92 per cent. of the nitrogen-free extract were digested, and all the carbohydrates appear to have been hydrolysed and absorbed in the digestive tract. Cows ate the material when mixed with other food, but not alone. When fed as an addition to a basal ration, the increase in milk obtained indicated its positive value as a productive food, though not equalling maize meal.

NOTE.—J. L. Baker and T. H. Pope (*J. Chem. Soc.*, 1900, **77**, 696) showed that the polysaccharide present in the ivory nut was a lævulomannan which on hydrolysis yielded about 95 per cent. of mannose and 5 per cent. of lævulose.

H. F. E. H.

Water-Content of Margarines prepared from Hydrogenated Fats. K. Brauer. (*Zeitsch. öffentl. Chem.*, 1916, **22**, 209-216.)—Hydrogenated fats and oils yield an emulsion containing more water than does an emulsion prepared with ordinary fats and oils, and, consequently, margarine made with hydrogenated fats is liable to contain more water than does margarine prepared under the same conditions from ordinary fats. The excessive quantity of water "held" by hydrogenated fats is not readily removed by kneading the mixture, and it is not unusual to find as much as 20 per cent. of water in this class of margarine.

W. P. S.

ORGANIC ANALYSIS.

Analyses, Purification, and Chemical Properties of Agar-Agar. C. R. Fellers. (*J. Ind. and Eng. Chem.*, 1916, **8**, 1128-1133.)—A number of old analyses of agar are collected, and sixteen new analyses of agar from various sources submitted. These sixteen analyses show a remarkable uniformity in composition. High percentages of ash (5 per cent.) or silica (1 per cent.) content are indicative of an inferior product. Considerable amounts of nitrogenous substances (1 to 3 per cent.) were found in all the samples.

A method of preparing purified agar is described. It consists essentially in washing the agar shreds in dilute acetic acid, washing out the acid, and precipitating, whilst hot, a 5 per cent. filtered solution of the agar by pouring into 4 or 5 volumes of 95 per cent. alcohol or acetone. This treatment removes much of the nitrogenous matter.

G. C. J.

Estimation of Arsenic in Organic Compounds. A. J. Ewins. (*J. Chem. Soc.*, 1916, 109, 1355-1358).—The substance (0.1 to 0.2 gm.) is mixed with about 0.25 gm. starch, 10 grms. of potassium sulphate, and 20 c.c. sulphuric acid, in a Kjeldahl flask, digested, and subsequently boiled until colourless. The cooled solution is neutralised with sodium hydroxide, faintly acidified with sulphuric acid, and made alkaline again with sodium bicarbonate, of which an excess (5 to 10 c.c. of a saturated solution) is added. The solution of alkali arsenite is then titrated with $\frac{N}{20}$ iodine, using starch as indicator, until the appearance of the characteristic deep blue colour. The method has been applied to a large number of organic compounds of arsenic, and has never been found to fail, whereas Lehmann's method (*Apoth. Zeit.*, 1912, 27, 545), excellent for salvarsan and neo-salvarsan, fails with benzarsenic acid and with dimethyl- and diethylbenzarsenic acids.

G. C. J.

Determination of Light Oils in Coal Gas, and Description of Still for separating the Light Oils from the Absorbing Oil. D. H. Duvall. (*Met. and Chem. Eng.*, 1916, 15, 626-627; through *J. Soc. Chem. Ind.*, 1917, 36, 25.)—After removal of hydrogen sulphide and naphthalene by successive treatment with sodium hydroxide and picric acid, measured quantities of gas are passed through a train of five or six bottles containing a suitable absorbent, preferably oleic acid. The light oils are then separated from this solution by distillation. The still and water-cooled worm condenser are made of copper. After raising the temperature of the "benzolised" oleic acid to about 100° C., steam is admitted from a separate generator, and a temperature of 180° C. is finally attained. The distillate is separated from water and subjected to distillation. The new distillate is saponified with sodium hydroxide to remove the last traces of oleic acid, then washed with water, dried with calcium chloride, and fractionally distilled in an Engler flask.

Mineral Constituents of Cotton Lint. J. H. Barnes. (*J. Soc. Chem. Ind.*, 1916, 35, 1191-1195).—Consignments of Indian cotton which had given irregular results in dyeing with aniline colours were found to contain from 0.073 to 0.014 per cent. of magnesium chloride. As this might have been artificially added by the cotton-growers to increase the hygroscopic capacity of the cotton, 18 genuine specimens of cotton lint of American, Egyptian, and Indian origin were examined with the following results: Moisture, 2.23 to 5.45; and ash (on dried lint), 1.27 to 3.99 per cent. The ash contained 4.44 to 31.72 per cent. of silica and silicates, and 2.23 to 6.55 per cent. of chlorine. The results showed that the samples of Chiniot (Punjab) cotton contained an unusually high amount of magnesium chloride, but that there was no ground for assuming that this had been intentionally added. The total amount of ash appears to have been under-estimated in the past, high results having been

attributed to foreign mineral matter present as dirt in the bale. The ash of genuine cotton may be upwards of 1 per cent., and the composition of the ash may vary within wide limits. It is highly probable that this will affect the reaction of the fibres towards dyestuffs, and it may also affect the tensile strength and keeping qualities of the cotton.

C. A. M.

Use of Methylene Blue as a Reagent in Chemical Analysis. Application of the Process to the Detection and Estimation of Perchlorates in Chile Saltpetre. A. Monnier. (*Arch. Sci. phys. nat.*, 1916, [iv.], 42, 210-216; through *J. Chem. Soc.*, 1916, [ii.], 110, 639-640.)—The following acids in dilute solutions, preferably in the form of their alkali salts, give coloured, crystalline precipitates with a solution of methylene blue. Hydriodic acid gives a deep blue precipitate, showing bronze-green by reflection; perchloric and hydroferricyanic acids, violet precipitates, bronze-green by reflection; persulphuric, dichromic, and permanganic acids, rose-violet precipitates, bronze-green by reflection; metavanadic, molybdic, and tungstic acids, deep blue precipitates. The precipitate with a persulphate is readily distinguished from that with a perchlorate in that the former when calcined leaves a slight residue showing the reactions of a sulphate, and the latter when heated decomposes violently with deflagration. The amount of potassium perchlorate can be readily estimated colorimetrically in a sample of Chile saltpetre by this method. To 20 c.c. of a 5 per cent. solution of the crude nitrate 1 c.c. of a 0.3 per cent. solution of methylene blue in water is added, and the mixture left overnight. A crystalline precipitate forms, and the supernatant liquid is tinted blue. This colour is compared with that of standard tubes containing varying amounts of pure potassium perchlorate. If the perchlorate is present to the extent of less than 0.2 per cent., a 10 per cent. solution of crude nitrate, and if more than 0.5 per cent., a 2.5 per cent. solution of crude nitrate, is used. If the crude nitrate contains any iodide, this can be first removed by shaking the solution with moist silver oxide.

INORGANIC ANALYSIS.

Estimation of Ammonia by the Boric Acid Method. L. Adler. (*Zeitsch. ges. Brauw.*, 1916, 29, 161-164, 169-172; through *J. Inst. Brewing*, 1916, 22, 500.—In the volumetric estimation of ammonia—*e.g.*, in the Kjeldahl method—it is usual to employ standard sulphuric acid as absorbing liquid. Winkler, in 1913, suggested the use of boric acid, which is practically neutral to methyl orange; and the author, as the result of experiments described, recommends the following modification of Winkler's method: The ammonia is absorbed in 50 c.c. of a 4 per cent. solution of pure crystallised boric acid contained in a 300 c.c. flask; these quantities, of course, need not be determined very accurately. The condenser tube should dip well below the surface of the absorbing liquid during the first fifteen minutes of distillation, but afterwards it can be raised so that the subsequent distillate serves to rinse the end of the tube. The condenser should be cooled by water, sufficiently to insure that the distillate reaches the absorption flask at room temperature. Twenty

minutes of vigorous ebullition suffices to distil all the ammonia. To insure the maximum of accuracy in the titration of the distillate it is advisable to employ a colour standard; this is prepared by treating 250 c.c. of distilled water with 0.15 c.c. of $\frac{N}{10}$ sulphuric acid and a few drops of a 0.05 per cent. solution of methyl orange. An orange-yellow tint is thus produced, which remains unchanged for a long time. The distillate, treated with the same amount of methyl orange, is titrated with $\frac{N}{10}$ sulphuric acid to the same tint, and the ammonia content is calculated from the volume of acid required, no correction being necessary for the boric acid present. The maximum amount of ammonia which can be absorbed without loss by the quantity of boric acid mentioned above (50 c.c. of 4 per cent. solution) was not determined, but it exceeds 70 mgrms. The results are as accurate as when sulphuric acid is used for absorbing the ammonia.

Efficiency of the Aeration Method for Distilling Ammonia. P. A. Kober. (*J. Amer. Chem. Soc.*, 1916, **38**, 2568-2572.)—The paper is a reply to various adverse criticisms on the efficiency of the aeration procedure in the ordinary Kjeldahl method for nitrogen determination as a means of quantitatively separating the ammonia. To insure accurate results in distilling ammonia by aeration it is necessary to use: (1) A sufficient volume of air; (2) as high a column but as low a volume of liquid as is convenient; (3) a saturated solution of pure sodium hydroxide in adequate excess (*ANALYST*, 1913, **38**, 581). An impure alkali containing sulphite is liable to cause error because of the sulphur dioxide evolved and carried over into the standard acid before the acid of the Kjeldahl mixture is completely neutralised. (4) Potassium hydroxide must not be used, because the difficultly soluble potassium sulphate which separates may carry down ammonia by occlusion or as a double salt. Errors of 10 per cent. may be caused in this way, but potassium sulphate as ordinarily used in the preliminary acid treatment is not sufficient to produce appreciable error (*ANALYST*, 1908, **33**, 442; 1909, **34**, 333; 1910, **35**, 316; 1916, **41**, 186, 386).

H. F. E. H.

Estimation of Rare Gases (Argon). A. Sieverts and R. Brandt. (*Zeitsch. angew. Chem.*, 1916, **29**, 402-406.)—The process described depends on the fact that metallic calcium at a dull red heat absorbs nitrogen and other gases with the exception of those of the argon group. When air only has to be removed from the argon the absorption may be made directly, but if the gas under examination contains large quantities of carbon monoxide, carbon dioxide, methane, etc., it is advisable to remove the greater part of these previously. The apparatus employed consists simply of a tube made of combustion glass for containing the calcium and a manometer attached to the tube by a movable joint; three-way taps are provided at the top of the two arms of the manometer and connect with the calcium tube, an inlet tube for the gas, an exhaust tube, and a tube for admitting air to one of the arms. About 5 grms. of metallic calcium are placed in the tube; the latter is placed horizontally in a small oven heated at 450° to 550° C., and the air is exhausted from the apparatus. The calcium tube is then removed from the oven, allowed to cool, and inserted vertically in a bath of cold water. The gas to be analysed is now admitted,

the pressure noted on the manometer, the calcium tube is heated as before for about one hour or until the pressure no longer decreases, then cooled, and the pressure observed at the same temperature as the previous reading. When the original pressure is denoted by P and the final pressure by p , the percentage by volume of rare gases present is $100p/P$.

W. P. S.

Boiling Method for Estimation of Water-Soluble Arsenic in Lead Arsenate.

G. P. Gray and A. W. Christie. (*J. Ind. and Eng. Chem.*, 1916, **8**, 1109-1113.)—Arsenical insecticides for spraying trees must be substantially free from water-soluble arsenic compounds, as these are violent plant poisons. For this reason the U.S. Legislature and those of the separate States of the Union have set limits to the permissible amount of soluble arsenic in such preparations, and, since methods of determining solubility are necessarily more or less empirical, the Association of Official Agricultural Chemists has recommended two methods with a view to insuring agreement between manufacturers' analysts and those of the States. One of these methods occupies more than ten days, a very serious objection from the point of view of the works laboratory, whilst it is shown in the present paper that the second method fails to extract more than 60 to 80 per cent. of the soluble arsenic, when the amount of this is considerable—that is to say, of the order of 1 per cent., 0.75 per cent. being the permissible limit.

The method now proposed consists in drying the preparation, mixing 0.5 gm. of the dried material with 200 c.c. ammonia-free water and boiling the mixture for ten minutes, after which it is digested on the steam bath until the undissolved matter settles. The solution is then filtered off, mixed with 4 c.c. sulphuric acid and 1 gm. potassium iodide, and concentrated to about 40 c.c., diluted to about 200 c.c. and any free iodine destroyed by the addition, drop by drop, of approximately $\frac{N}{20}$ thiosulphate solution. Methyl orange is added, and the solution nearly neutralised with sodium hydroxide. Sodium bicarbonate is then added in excess, and the arsenious oxide titrated with $\frac{N}{20}$ iodine solution.

The method differs from the earlier methods mainly in the use of boiling water for extraction of soluble matter, and in the great reduction of time required. It is shown that even prolonged boiling or digestion on the steam bath does not appreciably dissolve or hydrolyse lead arsenate. Yet the new method gives higher results, which lead to the conclusion that the earlier methods, which used water at room temperature or at 32° C., failed to extract the soluble arsenic completely.

G. C. J.

Qualitative Separation and Detection of Tellurium and Arsenic.

P. E. Browning, G. S. Simpson, and L. E. Porter. (*Chem. News*, 1916, **114**, 254.)—Tellurium is precipitated in the elementary form by means of sodium sulphite in dilute hydrochloric acid in presence of potassium iodide. The filtrate from the tellurium is boiled to remove excess of sulphur dioxide, treated with hydrogen dioxide, boiled to remove the greater part of the iodine, made alkaline with sodium hydroxide, and treated with more hydrogen dioxide to oxidise the arsenic to arsenate. The solution is then acidified, made alkaline again with ammonia, treated with magnesia mixture to precipitate the arsenic.

G. C. J.

Estimation of Boron in Boron-Steel. C. Aschman, Jun. (*Chem. Zeit.*, 1916, **40**, 960-961.)—It is found that when boric acid is heated at 1,000° C. with an excess of ammonium phosphate, the excess of the latter is volatilised completely and boron phosphate remains. A method based on this fact is described for the estimation of boron in boron-steel. A quantity of about 3 grms. of the steel is dissolved in dilute sulphuric acid in a flask attached to a reflux condenser; care should be taken to use the minimum quantity of acid for dissolving the metal. The ferrous sulphate is then oxidised by the addition of hydrogen peroxide and the mixture is distilled as far as possible; the distillate is collected in a receiver containing 0.5 gm. of ammonium carbonate dissolved in 20 c.c. of water, with the addition of a few drops of ammonia, and the outlet tube of the receiver is connected with a second receiver containing water. After the contents of the flask have cooled, 10 c.c. of absolute methyl alcohol, free from acetone, are added, and the distillation is continued; this addition of methyl alcohol followed by distillation is repeated five times. A current of air is drawn through the apparatus for some minutes between each distillation, and for thirty minutes after the final distillation. The contents of the receivers are then transferred to a weighed platinum basin containing 1 gm. of ammonium phosphate, the mixture is evaporated, and the residue heated at 1,000° C. in an electric oven until constant in weight. Results of experiments with steel and added quantities of boric acid show that the method is very accurate. W. P. S.

Qualitative Separation and Detection of Iron, Thallium, Zirconium, and Titanium. P. E. Browning, G. S. Simpson, and L. E. Porter. (*Chem. News*, 1916, **114**, 254-255.)—The hydroxides are dissolved in the least possible amount of sulphuric acid and the solution treated with hydrogen peroxide, a red coloration indicating titanium. The solution is made faintly alkaline with sodium hydroxide, and sodium phosphate is added. Sulphuric acid containing hydrogen peroxide is added until the solution is acid, the latter reagent serving to keep the titanium in the higher state of oxidation. The zirconium phosphate remains as a precipitate, and is filtered off. The iron and thallium in the filtrate are reprecipitated as hydroxides or phosphates by addition of sodium hydroxide, and the filtrate from the hydroxides is acidified with sulphuric acid and treated with sodium sulphite and a little more sodium phosphate to precipitate titanium as phosphate. The hydroxides or phosphates of iron and thallium are dissolved in sulphuric acid, the solution treated with sodium sulphite, and thallos iodide precipitated by addition of potassium iodide. The filtrate from the thallos iodide is boiled to remove sulphur dioxide, treated with hydrogen dioxide, again boiled to remove iodine and oxidise the iron, which is finally identified by the thiocyanate reaction. G. C. J.

Separation of Lithium from the Other Alkali Metals. S. Palkin. (*J. Amer. Chem. Soc.*, 1916, **38**, 2326-2332.)—Sodium and potassium chlorides are progressively precipitated from an aqueous solution by addition of alcohol and ether, the filtrate containing the whole of the lithium chloride and only traces of the other chlorides is evaporated to dryness, the residue extracted with absolute alcohol containing a drop of hydrochloric acid, and the last trace of sodium and potassium chloride in the resulting extract is precipitated by addition of ether.

The mixed chlorides (0.5 gm.) are dissolved in 1.5 c.c. water, one drop of concentrated hydrochloric acid is added, and then absolute alcohol (20 c.c.) drop by drop into the centre of the beaker, whilst its contents are rotated. Ether (60 c.c.) is added in a similar manner, and the mixture allowed to stand for five minutes. The precipitate is filtered off and washed with ether alcohol (4 : 1). The filtrate and washings are evaporated to dryness, and the residue taken up in 10 c.c. of absolute alcohol, warming if necessary, so that practically everything passes into solution. Ether (50 c.c.) is added in the manner above described, and one drop of hydrochloric acid. After allowing to stand for an hour, with frequent rotation, the solution is filtered from the small precipitate and the latter washed with ether-alcohol. The filtrate and washings are evaporated to dryness, and the residue is converted into lithium sulphate and weighed.

G. C. J.

Separation of Cæsium and Rubidium by Fractional Crystallisation of their Alums. P. E. Browning and S. R. Spencer. (*Amer. J. Science*, 1916, **42**, 279; through *Chem. News*, 1916, **114**, 285-286.)—The pronounced difference in the solubility of potassium aluminium sulphate and of the alums of cæsium and rubidium enables a satisfactory separation of potassium to be made, but the difference in the solubilities of cæsium and rubidium alums (0.62 and 2.3 parts in 100 parts of water at 15° to 17° C.) is too small for a rapid separation. About 22 fractional crystallisations were required before the cæsium had been completely eliminated from the rubidium. There is a much greater difference in the solubilities of the corresponding iron alums. Thus, 100 parts of water at 25° C. dissolve 2.7 parts of the cæsium alum and about 17 parts of the rubidium alum. After eight recrystallisations of the mixed alums the final fraction consisted of pure iron rubidium alum free from cæsium. On treatment with a strong solution of ammonium aluminium sulphate the more insoluble alums are readily thrown out of solution, and this affords a convenient method of separating cæsium from pollucite. It was found that 5 c.c. of a saturated solution of ammonium aluminium sulphate would give a perceptible precipitate with 1 c.c. of a solution of rubidium chloride containing 0.0002 gm. of rubidium, and with 1 c.c. of cæsium chloride solution containing 0.00005 gm. of cæsium.

C. A. M.

Estimation of Thorium and Mesothorium in Monazite. K. L. Kithil. (*Techn. Paper*, **110**, U.S. Dept. Interior, Bureau of Mines; *Chem. News*, 1916, **114**, 283-285.)—For the estimation of thorium in monazite the method of Metzger (*J. Amer. Chem. Soc.*, 1902, **24**, 901) is recommended. The quantitative estimation of mesothorium is effected in the same way as that of radium (Soddy, "The Chemistry of the Radio-Elements," p. 46; Rutherford, "Radio-active Substances and their Radiations," p. 550), the results being expressed in terms of the γ -ray activity of radium in equilibrium. If both radium and mesothorium are to be estimated, the γ -ray method is used for both substances together, and afterwards the radium is estimated alone by the emanation method. After the solution has been boiled, the γ -ray method gives only the amount of mesothorium, since the radium emanation is expelled by boiling, and radium C₁, which emits the γ -rays, is practically disintegrated after three hours'

time. The mesothorium obtainable from a ton of monazite sand is about 5.4 mgrms., but in practice only about 50 per cent. of that yield is obtained. It is sold on the basis of its activity compared with that of the purest radium bromide as estimated by the γ -ray method. For the separation of the minerals in monazite sands the conglomerate is first freed from larger gravel and clays, and is graded, before concentration, through sieves of 20, 50, 80, and 100 mesh, while clay and mica particles are removed by a sliming process. The properly graded material, when treated with a Wetherill electro-magnetic separator having two magnets and an 18-inch belt, gives the following results:

Mineral.	Specific Gravity.	Points at which Mineral Separated.	Current.
Magnetite	5.16 to 5.18	—	Very weak.
Ilmenite	4.5 to 5	First pole, first magnet; distance between poles, about 8 mm.	
Hæmatite	—		
Garnet	3.8 to 4.3	Second pole, first magnet; distance between poles, about 3 mm.	1 to 5 ampères.
Platinum (if any)	—		
Epidote	3.2 to 3.5		
Apatite	3.2 to 3.25		
Olivine	3.3 to 3.6		
Tourmaline	3.0 to 3.2	First and second pole of second magnet; distance, first pole 6 mm.; second pole 2 to 3 mm.	12 to 15 ampères.
Monazite (92 to 95 per cent.) and traces of zircon and rutile.	4.8 to 5.3		
Platinum, etc., if any.	—		

Residues off the belt are quartz (2.65), felspar (2.5 to 2.7), gold, zircon (4.5 to 4.7), rutile (4.2 to 4.25), etc. C. A. M.

Oxalate-Iodide Method for Paris-Green Analysis. C. A. Peters and L. E. Fielding. (*J. Ind. and Eng. Chem.*, 1916, 8, 1114-1115.)—The sample (0.25 gm.) is treated with 1 c.c. of dilute (1:10) sulphuric acid and 50 c.c. water, and the mixture boiled for two minutes. Whilst still hot, about 2 grms. of oxalic acid crystals are added, little by little, as the first addition is apt to give rise to violent frothing. The mixture is again heated to boiling and then allowed to stand overnight. The copper oxalate is filtered off on asbestos, washed with water, and the crucible, asbestos, and precipitate are then placed in the original beaker, water and 5 to 10 c.c. of dilute (1:1) sulphuric acid are added, the temperature is raised nearly to boiling, and the oxalic acid titrated with permanganate. From the consumption of permanganate the copper is calculated.

The filtrate from the copper oxalate is neutralised with sodium bicarbonate, of which an excess is then added, and the arsenic is titrated with iodine solution. Test numbers show that the method is as accurate as others commonly used for the analysis of Paris green. G. C. J.

Estimation of Phosphorus Pentoxide after Citrate Digestion. O. C. Smith. (*J. Ind. and Eng. Chem.*, 1916, 8, 1127-1128.)—Difficulty is sometimes experienced in obtaining a clear solution of the fertiliser and filters left after the removal of reverted

phosphate by the digestion with neutral ammonium citrate. By the use of the following method a clear solution can be obtained in less than an hour. The precipitate and papers are treated with 10 c.c. sulphuric acid and 50 c.c. dilute (1:1) nitric acid, and the mixture is digested in a flask on a hot plate until fumes of sulphuric acid arise. One or two c.c. of nitric acid are added and digestion continued until the appearance of sulphuric acid fumes, after which the treatment is repeated. A clear solution nearly always results at this stage. If it does not, further treatment with nitric acid will readily clear it. After neutralisation with ammonia and addition of ammonium nitrate, the phosphorus is precipitated in the usual way. G. C. J.

Quantitative Estimation of Small Quantities of Sulphate. H. J. Hamburger. (*Proc. K. Akad. Wetensch. Amsterdam.*, 1916, **19**, 115-125; *Biochem. Zeitsch.*, 1916, **77**, 168-188; through *J. Chem. Soc.*, 1916, **110**, ii., 641.)—The microvolumetric method, already applied in the estimation of small quantities of potassium, has been found to yield satisfactory results in the estimation of sulphate by precipitation as barium sulphate. The precipitate is forced into a calibrated capillary tube by centrifuging, and, when constant, the volume of the precipitate is read off. The tube is calibrated by preliminary experiments with solutions containing known quantities of sulphate. Experiments showed that the volume of a given quantity of precipitated barium sulphate depends on the size and shape of the crystals, and it has been found necessary to carry out the precipitation under certain definite conditions. In particular, it is essential that the precipitated barium sulphate should consist of very small crystals, and this result may be attained by the addition of acetone. The procedure adopted is to add 2.5 c.c. of hydrochloric acid (1:1) to 5 c.c. of the sulphate solution; to this solution are added 5 c.c. of a barium chloride solution (2.4 per cent. $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$) containing three to five drops of acetone. When the estimation is carried out in this manner the result obtained is not affected by the presence of sodium, potassium, calcium, magnesium, chloride, or phosphate in the original solution.

Sublimed Sulphur and its Adulteration. Fonzes-Diacon. (*Ann. Falsif.*, 1916, **9**, 333-339.)—Sublimed sulphur (flowers of sulphur), when well prepared, contains about 32 per cent. of sulphur which is insoluble in carbon disulphide (*cf.* Bruno, *ANALYST*, 1910, **35**, 279). The proportion of this insoluble modification, however, decreases slightly when the sulphur is kept, and is less in specimens collected in the condensing chamber at a point near the inlet for the hot vapour. The latter specimens contain much coarse matter, and the author finds that the finer portions of the powder, after sifting, still show a high percentage of insoluble sulphur. Ground sulphur, on the other hand, is almost entirely soluble in carbon disulphide. If sublimed sulphur is sifted through a 100-mesh sieve and then through a 140-mesh sieve, and the insoluble sulphur determined in the portions which do not pass through the two sieves, respectively, the ratio of the insoluble sulphur in the coarser powder to that in the finer powder will always be less than unity. For instance, the coarser portion of a sample of genuine sublimed sulphur contained 15.1 per cent. of insoluble sulphur, and the finer portion 21.3 per cent., giving the ratio of 15.1/21.3. In other

words, the finer portion of the powder contains the more insoluble sulphur. With ground sulphur, when it contains any insoluble sulphur, the coarser portion will contain more insoluble sulphur than does the finer portion, and the ratio will be greater than unity. If, therefore, a sample of sulphur be sifted through sieves of the dimensions given, and the insoluble sulphur estimated in the portions which remain on the sieves, the presence of not less than 25 per cent. of ground sulphur is indicated when the ratio between the two quantities of insoluble sulphur approaches near to or exceeds unity. With more than 30 per cent. of ground sulphur, the ratio is always above unity.

W. P. S.

Quantitative Estimation of Small Quantities of Sulphide Sulphur. W. A. Drushel and C. M. Elston. (*Amer. J. Sci.*, 1916, **42**, 155; through *Chem. News*, 1916, **114**, 272-273.)—The method depends on the liberation of hydrogen sulphide and its quantitative absorption by lead acetate paper, the stain being then compared with standard stains produced by decomposing solutions of sodium sulphide containing from 0.0002 to 0.004 per cent. of sulphide sulphur. The apparatus consists of a round-bottomed flask through the cork of which is passed the smaller end of a Liebig condenser, slightly shortened and drawn downwards, while across the upper end is tied a filter paper moistened with dilute lead acetate solution. In preparing the standard stains the sodium sulphide solution, containing exactly 0.01 per cent. of sulphide sulphur, is diluted with nitrite-free distilled water to the required extent, and quantities of 1 to 5 c.c. are gently boiled with 25 c.c. of 0.5 per cent. hydrochloric acid in the flask, so that the steam passes not too rapidly through the lead acetate paper. In test experiments with sodium sulphide the method was found to be accurate within 0.0003 per cent. for solutions containing not more than 0.001 per cent. of sulphide sulphur. In using the method for the estimation of hydrogen sulphide in air, 25 litres of the air are slowly drawn through an absorption bulb containing dilute potassium hydroxide solution, and this is subsequently diluted, and an aliquot portion is boiled with hydrochloric acid in the apparatus. The method is capable of detecting less than 1 part of hydrogen sulphide in 5,000,000 of air, and gives concordant results. For the estimation of sulphur in coke from 5 to 10 grms. of the sample are boiled with dilute hydrochloric acid and the hydrogen sulphide absorbed by dilute potassium hydroxide solution, as in the ordinary method of Fresenius. The absorbed sulphur is subsequently estimated colorimetrically in aliquot portions of the alkaline liquid. The results quoted are practically identical with those given by the gravimetric method. A further application of the method is in the analysis of paper, portions of 1 to 2 grms. being tested in the apparatus. Samples of tissue paper thus examined contained from 0.0002 to 0.001 per cent. of sulphide sulphur, and it was found that when papers containing the larger amounts were used for wrapping articles of polished silver a pronounced tarnish appeared on the metal in the course of two to three weeks.

C. A. M.

Estimation of Sulphur in Iron and Steel. H. B. Pulsifer. (*J. Ind. and Eng. Chem.*, 1916, **8**, 1115-1123.)—The paper includes a bibliography with 285 entries. The methods available are classified and briefly discussed. Particular attention is

directed to the relation between fineness of sample and probable error of sampling, in view of the fact that sulphur in iron and steel tends to segregate in that portion of an ingot which solidifies last. If it be desired that the third figure to the right of the decimal point should have any significance in a statement of percentage of sulphur in steel, and if 5 grms. of metal be taken for analysis, then the sample should pass an 80-mesh sieve. With coarser material, several analyses must be made to estimate the probable error due to irregular distribution of the sulphur. Experiments are described demonstrating the accuracy of the nitric acid method. Bamber's method is shown to give results which are nearly always high, but not uniformly high, and this is attributed to the access of sulphur from dust in the air during the prolonged digestions required by this method. In the author's hands, the chlorate method gives excellent results, its chief advantages being the almost instant and gentle solution of the iron and the avoidance of the use of nitric acid. It is also rapid. On the other hand, the accompanying use of hydrofluoric acid raises difficulties. Not only is glass apparatus attacked, but the barium sulphate may become contaminated by sodium fluosilicate, which is difficult to wash out.

G. C. J.

Analysis of Certain Tungsten Derivatives. O. R. Sweeney. (*J. Amer. Chem. Soc.*, 1916, **38**, 2377-2383.)—Arsenic can be separated from mixtures of sodium tungstate and arsenate as follows: The mixture is heated in a combustion-tube to 300° C. in a current of hydrogen chloride. In this way the arsenic is fully removed to a suitable receiver in four hours. The contents of the combustion-tube are rinsed into a dish with dilute ammonia, the solution evaporated to dryness, and the residue digested with dilute (1:1) nitric acid, adding small quantities of hydrochloric acid from time to time. When all action has ceased the liquid is evaporated and the residue repeatedly moistened with nitric acid, which is evaporated to expel the last traces of chlorine. The residue is dissolved in sodium hydroxide, the solution diluted, filtered, neutralised with nitric acid, and the tungstic acid precipitated by addition of mercurous nitrate solution.

Complex salts, such as sodium arsenio-tungstate or antimonio-tungstate, should be weighed into small tubes open at both ends. These tubes are placed in a combustion tube and heated to 200° C. for an hour in a current of dry hydrogen chloride. The apparatus is cooled, the residue moistened with water, and heated again for thirty minutes in a current of hydrogen chloride. This treatment is repeated three times. The tungsten in the residue is then estimated as already described. The most convenient way to secure a correct temperature of the furnace is to turn the gas up slowly until tungstic acid just begins to volatilise, and then to check it somewhat.

Sodium vanadio-tungstate cannot be analysed as above described, but if chlorine be mixed with the hydrogen chloride, the vanadium can be completely expelled at about 200° C. A suitable form of combustion tube and a convenient oven (formed of a tin box) are figured in the text, which includes detailed directions for insuring that the separations shall be quantitative.

G. C. J.

Separation of Vanadium from Phosphoric and Arsenic Acids and from Uranium. W. A. Turner. (*Amer. J. Sci.*, 1916, **42**, 109; through *Chem. News*, 1916, **114**, 261-262.)—The method of estimating vanadium in a metavanadate solution by precipitation with "cupferron" (*ANALYST*, 1916, **41**, 261) is also applicable to its separation from phosphoric and arsenic acids, the only difference being that a more thorough washing of the precipitate is required. For the estimation of vanadium in presence of uranium (uranyl nitrate) it is necessary to make the precipitation from a fairly strong (10 per cent.) sulphuric acid solution, to prevent the formation of insoluble uranyl vanadate, and to use an acid solution of about the same strength, containing 1.5 grms. of cupferron per litre, for washing the precipitate. To effect a more complete separation the washed precipitate is dissolved in ammonia solution, and the liquid rendered nearly acid, and cooled to 20° C., before completing the acidification and again precipitating the vanadium. The uranium in the filtrate may be estimated by the ammonium hydroxide method. The results thus obtained were about 0.002 gm. too low on 0.110 gm. of vanadium, while the amounts of uranium were in close agreement with theory. C. A. M.

APPARATUS, ETC.

Interferometer in the Brewery Laboratory. L. Adler and H. Lüers. (*Zeitsch. ges. Brauw.*, 1916, **39**, 17-19, 25-28, 33-35, 41-43; through *J. Inst. Brewing*, 1916, **22**, 504-509.)—The construction and *modus operandi* of the Löwe-Zeiss interferometer are explained, and experiments are described, the object of which was to ascertain to what extent the instrument can be usefully applied to analytical work in

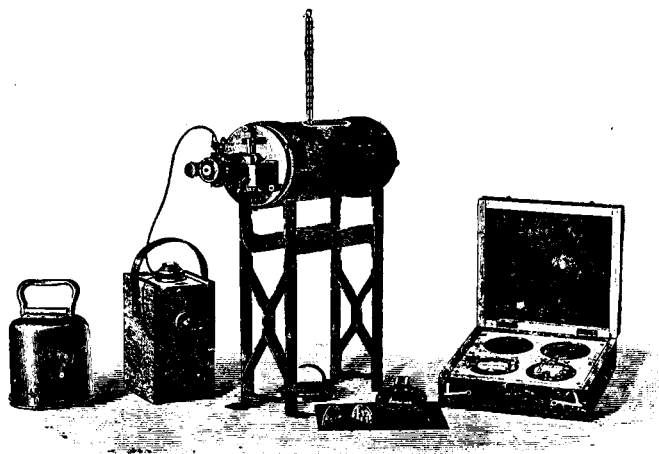


FIG. 1.

the brewery laboratory. Fig. 1 represents the instrument encased in a cylindrical heat-insulating mantle, and supported on a stand, together with an accumulator for operating the source of light, a box containing extra chambers, and a protective helmet for the instrument when not in use. Fig. 2 is a diagrammatic representation

of the working parts in plan (above) and elevation (below). The instrument is essentially one for measuring very small differences between the refractive indices of two liquids. Light from the source *B*, following the path shown, traverses the two glass plates, P_1 and P_2 , of the compensator *K*, and after passing through the attenuating bath *Tr*, containing water, is reflected from the mirror *S*, and observed through the eye-piece *Ok*. The field, as thus observed, exhibits a series of vertical interference bands, of which the middle ones are the most intense. When the re-

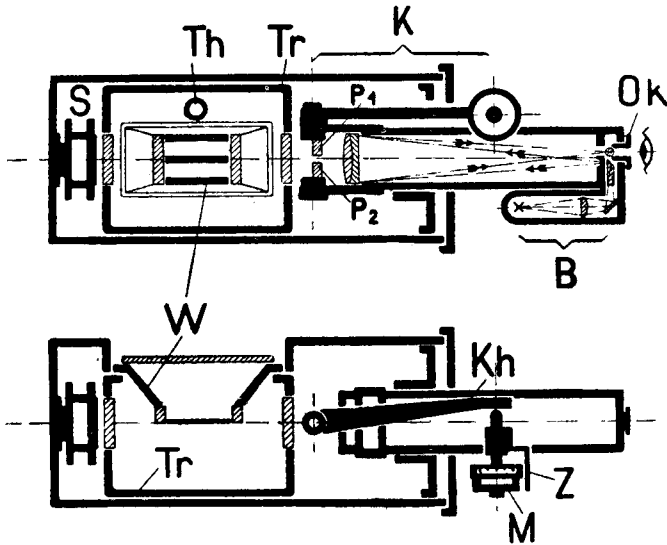


FIG. 2.

ceptacle *W*, for the liquids under examination is placed in the instrument, the upper half of the beam of light has to traverse this receptacle, which has parallel glass end-plates and is divided longitudinally by a vertical partition into two chambers, so that one part of the upper half of the beam of light traverses one chamber and the other part traverses the other. If the two chambers contain liquids of exactly the same refractive index, the interference bands in the upper half of the field will correspond in position with those in the lower half, as in Fig. 3; but if the liquids differ in refractive index, one of them will cause a relative retardation of the light passing through it, and the bands in the upper part of the field will be displaced to the right or left. To restore the bands to their original position the relative retardation mentioned is compensated by slightly tilting the glass plate P_1 (so as to interpose a greater thickness of glass in the path of the non-retarded portion of the beam of light). The plate P_1 is tilted by raising or lowering the lever *Kh* by means of the screw *M*, with a graduated head. The number of divisions on the screw head, through which it has to be turned to restore the bands in the upper part of the field to their zero position, constitutes the interferometer reading, and is taken as a measure of the difference

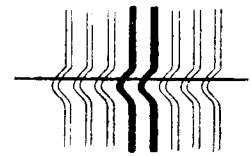


FIG. 3.

in refractive index between the liquids (or gases) in the two chambers. According to the length of the chambers used (0.5 to 5 cm.), the instrument is from 7 to 60 times as sensitive as the immersion refractometer, but its range of measurement is correspondingly less.

The authors first applied the instrument to the determination of wort gravities. The worts were diluted tenfold, and compared with distilled water. The instrument was first calibrated by determining the readings for a series of worts whose gravity had been previously determined pycnometrically. By plotting the readings against the true gravities a straight-line graph was obtained, which was then used for finding the gravities of a number of other worts from their interferometer readings. The dilution of the worts was carried out with the greatest care. The results for 13 worts showed errors ranging from 0 to 1.5 in the fourth place of decimals in the gravity (e.g., 1.03345 found instead of 1.0336 as determined pycnometrically). Similar experiments in which the worts were diluted only fourfold (and compared with water) gave results in which the average error was 5 to 6 in the fifth place of decimals of the gravity (e.g., 1.0336 found instead of 1.03365), and the maximum error between two and three times as great. Owing to the extreme care required to avoid introducing errors in diluting the wort, the determination of gravities by this method could not be regarded as more convenient than the pycnometric method. The authors therefore made observations with undiluted worts, and used for comparison a solution of monopotassium phosphate containing 10 grms. per 100 c.c. The results for 35 different worts gave a straight-line graph, with an average discrepancy in individual cases corresponding to 5 in the fifth place of decimals of the gravity (e.g., 1.03375 instead of 1.0337), and a maximum discrepancy of nearly three times as much. With some practice, the determination of gravity in this way occupied five minutes at the outside, but with dark worts the readings were difficult and somewhat uncertain, and in such cases it would probably be preferable to operate with the wort diluted fourfold and compare it with water.

Marc has previously shown how the interferometer can be used for the determination of dissolved colloids in liquids by taking readings before and after treatment of the liquid with a substance such as barium sulphate which adsorbs the colloids. In some experiments of this kind with worts and beers the authors employed purified blood charcoal instead of barium sulphate, and used only a relatively small amount so as to avoid the removal of high-molecular crystalloids. Although by this method only a fraction of the total colloids present was removed, it was thought that useful comparative results would be obtained by adhering to a standard procedure. The procedure finally adopted was to treat 50 c.c. of wort with 0.25 gm. of charcoal for half an hour, with frequent agitation, and then filter. The difference between the interferometer readings before and after this treatment is designated the "colloid-number." It was found to vary considerably with different worts, but the data obtained are not yet sufficiently numerous to warrant general conclusions.

For the examination of waters the interferometer is much more useful than the refractometer, owing to its greater sensitiveness, and its possibilities in this direction have been pointed out by Marc and Sack (*Kolloidchemische Beihefte*, 1914, 5). The interferometer reading of a water (compared with distilled water) gives an indication

II. VARIOUS OILSEEDS.



Myrsine polyperna.



Ucubaba.

Myrsine bicubiba.



Maboula Panzo.



Pentaclethra macrophylla.

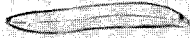


Manna.



Piroa-cary.

Pentaclethra filamentosa.



Andiroba.

Carapa guianensis.



Marmoraria.

Rochira sp.

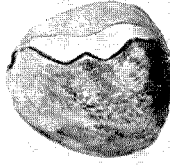


Sacha Almondria.

Caryocar sp.



Mahuba-rana.



Cayete.

Omphalea megacarpa.

of the amount of total solids present. The ratio of total hardness to permanent hardness may also be estimated by taking readings of the water in its original condition and after it has been boiled, filtered, and diluted with distilled water to the original volume. The readings of different waters are not strictly comparable, but for waters of similar composition they furnish a very exact measure of the total solids. A comparison of the amounts of dissolved colloids in different waters may be made by the method of adsorption described above for worts; the inorganic salts present are not adsorbed by the charcoal under the conditions indicated. The presence of colloidal matters in water in which barley has been steeped is easily shown in this way, and it would probably be possible to use the interferometer as a check on the efficiency of the steeping and washing process.

The extraordinary sensitiveness of the interferometer makes possible the determination of the concentration of very dilute solutions of any single substance when once the instrument has been calibrated for that particular substance. For example, the authors obtained a reading of 2 with a solution of 0.1 c.c. of $\frac{N}{10}$ sodium hydroxide in 100 c.c. of water, using the 1 cm. chambers. The concentration of dilute solutions of furfural can also be determined, and the possibility of applying the interferometer to the estimation of pentosans is being investigated.

The Zeiss instrument is provided with special chambers, 10 cm. long, for observations with gases, and it can be used for the estimation of any one constituent of gas mixtures. For this purpose it is necessary to fill one chamber with the gas under test, and the other with the same gas from which the constituent to be determined has been removed. Thus, in the estimation of carbon dioxide in flue gas, the gas is dried and passed first through one of the two chambers, then through a tube containing soda-lime to absorb carbon dioxide, and then through the other chamber. After the gas has been flowing for a sufficient time to sweep out the chambers, the flow is stopped and a reading is taken. The results obtained by this method are slightly high, if the instrument has been calibrated by means of mixtures of carbon dioxide and air. This is because the soda-lime absorbs sulphur dioxide as well as carbon dioxide from the flue gas. The slight error may be avoided by removing the sulphur dioxide, by means of lead peroxide, before the gas is passed through the first chamber. The carbon dioxide can then be determined with a possible error of less than 0.1 per cent.

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MATERIA MEDICA AND THERAPEUTICS, by J. MITCHELL BRUCE, M.A., LL.D., M.D., F.R.C.P., and WALTER J. DILLING, M.B., CH.B. Cassell and Company, Ltd., London, 1915. Price 6s. 6d. net.

This, the tenth edition of a well-known work, is practically a new book, and is a great improvement on previous editions. Pharmacology has made such remarkable progress during the last ten years that a volume of this character becomes useless unless it is completely recast by its authors from time to time. This has now been done, rendering it serviceable to medical and chemical practitioners as well as to students. In it the authors have been at great pains to make reference to the more important of recent published researches in pharmacology and in the chemistry of medicinal substances.

In this work an attempt is made to group drugs in accordance with their pharmacological actions and therapeutic uses. Such an arrangement is, on the whole, admirable, being, no doubt, of assistance to students of medicine and pharmacy in rapidly appreciating and remembering facts which otherwise are difficult to retain. It also has the merit of making conspicuous by their absence, or by reason of their being classified as of remote activity, those drugs whose claim to therapeutic value rests only on traditional use, although they are still retained in pharmacopœias.

The relation between chemical constitution and physiological action being remote, and so little understood, it is a pity that the authors divide materia medica into two parts under the headings "The Inorganic Materia Medica" and "The Vegetable and Animal Materia Medica and Synthetic Preparations," making a division which is naturally difficult to maintain while at the same time classifying materia medica in accordance with their therapeutic uses. Notwithstanding a good index, we find that the book suffers from this complex arrangement—for instance, salvarsan, citric acid, iodoform, and zinc acetate are dealt with among inorganic substances in Part I., while hydrocyanic acid, chloroform, and zinc valerianate are dealt with in Part II.

Reference is made to most or all of the important synthetic remedies of recent introduction, but the authors wisely omit reference to innumerable synthetic substances of lesser importance which have been introduced, chiefly from Germany, during the last ten years.

The introduction contains much which is badly expressed from a scientific standpoint, and it is to be hoped that in future editions such generalisations as the following, which are taken at random, will be worded afresh: "Synthetic compounds are derived from various chemical substances of the carbon series," "the radical glyceryl, C_3H_5 "; "Tabellæ-Tablets are small flat pieces of chocolate containing a minute quantity of an active substance"; and "Alkaloids are active nitrogenous principles formed within organic bodies, and may be regarded as compound ammonias."

Nevertheless, the main part of the book is free from this weakness, and it is, we think, one of the best of its kind and valuable to students.

FRANCIS H. CARR.

ELEMENTARY PRACTICAL CHEMISTRY. PART II.: ANALYTICAL CHEMISTRY, QUALITATIVE AND QUANTITATIVE. By FRANK CLOWES, D.Sc., and J. B. COLEMAN, A.R.C.S. Eighth Edition. London: J. and A. Churchill. 1916. Price 3s. 6d. net.

Amongst the numerous text-books on practical inorganic chemistry, those of Professor Clowes and Mr. J. B. Coleman have secured well-merited recognition, and the issue of an eighth edition of their elementary book on qualitative and quantitative analysis is a further tribute to the service these authors have rendered to laboratory instruction.

In this edition some new matter has been introduced and some alterations in the sequence of subjects have been made. Otherwise it follows the order of previous editions, and comprises qualitative analysis, volumetric and gravimetric analysis, inorganic preparations, and an appendix containing a number of useful numerical and other data. An ample number of exercises are provided in each of the sections, from which a judicious selection is available according to the varying requirements of students.

The relative position of qualitative analysis in the chemistry curriculum of schools and colleges has been the subject of much discussion during recent years, and many teachers consider it preferable that it should be preceded by elementary volumetric work, for it must be recognised that the effective teaching of qualitative analysis both as a training in the methods of observation and as a necessary basis for the further practical study of chemistry necessitates considerable previous knowledge of the subject-matter concerned. It is, however, of course, quite open to teachers and students to vary the order of the curriculum provided in this volume.

In the sections dealing with quantitative analysis there are several instances in which the methods described could be advantageously modified so as to bring them more into accord with those of actual practice. For example, under the heading of acidimetry and alkalimetry, the preparation of normal sulphuric acid is described as the standard acid for use, normal hydrochloric acid being relegated to a secondary position, whereas the latter is generally employed and has several distinct advantages. Again, the standardisation of potassium permanganate solution by means of sodium oxalate is preferable to the use of metallic iron or of ferrous sulphate, and the volumetric correlation of potassium dichromate and iodine solutions is also an exercise of practical value which could be advantageously included. Similarly, in the gravimetric exercises the use of the Gooch crucible for such estimations as that of silver as silver chloride and of potassium as the chloroplatinate are well within the capacity of an elementary student, and are likely to lead to more accurate results than the methods described. The estimation of copper by precipitation with sodium or potassium hydroxide is a further instance of a method that has little to recommend it, and which is but rarely employed. It is only with very great care that accurate results

can be obtained, and certainly in the hands of elementary students ignition in accord with precalculation is not an unknown means of arriving at data which will be passed by the censor.

Similar criticism might be offered in regard to some of the other exercises described, but, apart from this point of view, the range and variety of the examples chosen are very good, and the description of the processes concise and clear, so that the book will, without doubt, continue to enjoy the confidence of teachers.

CHARLES A. KEANE.

A HANDBOOK FOR CANE-SUGAR MANUFACTURERS AND THEIR CHEMISTS. GUILFORD L. SPENCER, D.Sc. Fifth Edition. 93 illustrations. John Wiley and Sons, Inc., New York; Chapman and Hall, London. 1916. \$3.50 net.

In the fifth edition Dr. Spencer has considerably increased the value of his well-known handbook by amplification of matter and by bringing the subjects dealt with up to date. Treating in the first instance of the physiology and methods of cultivation and reaping of the sugar-cane, the author goes on to give an outline of the general method of manufacture of cane-sugar, dealing with the various stages of the process, including the important subjects of plantation white sugar and the treatment of massecuites, in subsequent chapters. The process of refining raw sugar is then described. The greater part of the work, however, is devoted to the laboratory side of the subject. The various bodies met with in the sugar-cane and its juice are set forth, together with the optical and chemical methods of analysis required for the necessary estimations. Further chapters are devoted to the chemical control of the factory and details of sugar-house calculations, and the balance of the work comprises directions for the analysis of the various chemical agents used in sugar-making, with a description of special reagents required in the laboratory of a sugar factory, and 140 pages of tables likely to be of use to the sugar chemist.

Dr. Spencer has compressed an enormous amount of valuable information within the confines of his book, imparted in concise and lucid language. As, however, might be expected from his immediate associations, Louisiana and Cuba loom very largely in his perspective, with the result that a good deal of what is going on in the outside world has escaped recognition. Thus, he states that the most extensive use of seedling canes is in Java, no reference whatever being made to the great work done in this direction in British Guiana, the British West Indies, and Mauritius. The only types of filter-presses he illustrates are American, no mention being made of the almost universal Kroog press, or of the Philippe gravity press. He describes, among plantation white sugar processes, the "nonto" process as a recognised process, whereas its application to raw juices in the Brazils, Natal, and Java has not been a success. Again, under the heading of multiple evaporation, only the standard centre circulating tube type is referred to; nothing is said as to other and successful types.

It is extremely doubtful whether levulose is present in the healthy cane, as Dr. Spencer avers, and his statement that dextran, the high rotating body produced during the growth of *Leuconostoc mesenteroides*, is calculated to lead to false results

in the estimation of sucrose in cane-juice by polarisation does not agree with the experience of Dr. Prinsen Geerligs, the well-known Java expert, who states that dextran is precipitated by the basic acetate of lead used in preparing juice for the polariscope.

It is a pity that Dr. Spencer has not had the courage of his opinions, and omitted all reference to the analysis of the sugar-cane as a basis of purchase. After pointing out the impossibility of obtaining a representative sample of cane from truck or cane-carrier, he describes how the cane may be sampled and analysed for this purpose. It is also a pity that such an able exponent of the art of sugar-making should lend his support to inferential methods of obtaining results and to the use of empirical formulæ. Thus, he reproduces well-known formulæ for calculating the "available" sugar from the relation of the "non-sugars" to the sucrose. These non-sugars consist of bodies which not only individually vary in melassigenic properties, but also in the relation of their proportions to one another. Any calculation on the basis of these lumped-together non-sugars must be purely empirical. The true amount of sugar "available" for sugar-making purposes is the total quantity present in the cane-juice; and, however Utopian it may seem, it is the entire recovery of this as merchantable sugar which should be the aim of the sugar chemist, not the recognition of a limit of recovery short of this. Again, why should attempts be made to express the composition of "normal" juice—that is, the juice without maceration water—by an equally tainted formula? It is not the composition of the "normal" juice the sugar-maker wants the knowledge of, but of the juice that comes to his hand to be made into sugar.

But the cane-sugar-making world is indebted to Dr. Spencer for an excellent and most useful book, the utility of which is aided by the pocket form in which it is issued and the fine manner in which it is printed and edited.

FREDERIC I. SCARD.

THE GAS CHEMISTS' SUMMARY, 1915. By A. V. HENDRICKSON. London: Walter King. 1916. 3s. 6d. net.

The gas industry, for long looked upon as a branch of engineering, is slowly taking its place as a chemical industry. Notwithstanding the great advances made in appliances for the carbonisation of coal and for the distribution of the principal product by engineers, it has been felt that carbonisation itself and the successful working up of products depend upon chemical changes of a by no means simple nature. The little book under review is in itself a symbol of that feeling. The second of, it may be hoped, a long series, it presents readable abstracts of papers published in 1915 on subjects more or less directly connected with the industry. The chapter headings are: I. Carbonisation. II. Condensation, Washing, Purification, Naphthalene and Cyanogen Extraction. III. Tar and Ammonia. IV. Oil and Carburetted Water-Gas. V. Photometry and Calorimetry. VI. Gaseous Heating and Ventilation. VII. Gas Analysis. VIII. Tests. IX. Miscellaneous. There is also a bibliography.

One is surprised to see that Professor Kendall, writing on the anthracite problem, refers to lime as an exceedingly rare constituent of existing plants, although his view

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may be correct that the absence of potash in the ash of anthracite is due to its removal (by solution?) rather than to an original difference, as suggested by the Geological Survey. The work of Jones and Wheeler and of Parr on the carbonisation of the fractions of coal obtained by solvents receives full notice. A curious method of stating results of gas analysis in which olefines and ethylene are mentioned separately attracted attention. In the original paper by Jones and Wheeler no clue was found, although the same statement occurred. Earlier papers show that (higher) olefines are absorbed by ordinary strong sulphuric acid, whereas ethylene is absorbed by bromine. A study by O. Simmersbach of the effect of the temperature of carbonisation on the fate of nitrogen in coal shows that with increasing temperature more nitrogen comes off as ammonia, as cyanogen, in the tar, and as free nitrogen, much less remaining in the coke at the higher temperatures.

Tar and ammonia and the recovery of benzene and toluene naturally receive even more attention than in "piping times of peace." One notes that by washing gas with tar the value of the latter can be increased by as much as a penny a gallon, owing to the increase of benzene, toluene, and solvent naphtha.

The determination of benzene in gas by Burrell and Robertson's cryoscopic method is described, but their similar method for petroleum vapour is not mentioned, although their combustion process, based on the convention that the vapour is pentane, is alluded to. The method of freezing out, pumping out the fixed gas, and then taking the tension at atmospheric temperature of the residual hydrocarbons, is distinctly good, and available wherever solid CO₂ or liquid air, as the case may be, is obtainable. J. T. Dunn points out, as the writer has done, that the so-called net calorific value of gas is purely arbitrary, inasmuch as all products of combustion other than water are ignored.

The book is interesting and full of matter, on the whole well selected, although the author is entirely uncritical in his abstracts. The misprints are few but striking,

J. H. COSTE.

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INSTITUTE OF CHEMISTRY

PASS LIST: JANUARY (1917) EXAMINATIONS.

THE results of the Examinations of the Institute of Chemistry recently held in London have now been published.

Four Candidates passed the Final (A.I.C.) Examination—viz., in the Branch of Organic Chemistry: J. W. Ingham, B.Sc. (Lond.), and E. W. J. Mardles, B.Sc. (Lond.); in the Branch of the Chemistry (and Microscopy) of Food and Drugs, Fertilisers and Feeding Stuffs, Soils, and Water: Alan Haythornthwaite, B.Sc., A.R.C.S. (Lond.), and Ernest Paul, B.Sc. (Lond.).