THE ANALYST

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

AN Ordinary Meeting was held on Wednesday, May 3, 1922, at the Chemical Society's Rooms, Burlington House. The President, Mr. P. A. Ellis Richards, F.I.C., was in the chair.

Certificates were read for the first time in favour of Messrs. Archibald Steele Whamond and Thomas John Ward.

A Certificate was read for the second time in favour of Mr. Frederick Major, B.Sc. (Lond.), A.I.C.

The following were elected Members of the Society:—Messrs. William John Agnew, B.A. (R.U.I.); Arthur Thomas Etheridge, M.B.E., B.Sc. (Lond.), F.I.C.; Reginald Ernest Essery, B.Sc. (Bristol), A.I.C.; George Girvan Herbert, A.I.C.; George Lewis Hutchison, B.Sc. (Lond.), F.I.C.

The following papers were read:—"Studies in the Titration of Acids and Bases," by J. L. Lizius, B.Sc., A.I.C., and Norman Evers, B.Sc., F.I.C.; "Graphites and other Pencil Pigments," by C. Ainsworth Mitchell, M.A., F.I.C.; "The Sulphuric Acid Reaction for Liver Oils and its Significance," by J. C. Drummond, D.Sc., F.I.C.; and "Inadequacy of 'A.R.' Test for Alkalis in Calcium Carbonate," by W. Singleton and H. Williams.

Obituary.

ALFRED HILL.

DR. ALFRED HILL, F.I.C., who died on February 22nd in his ninety-sixth year, was not only one of the founders of the Society of Public Analysts but was the oldest surviving English Public Analyst—he having been appointed as Public Analyst for Birmingham as long ago as 1860 under the "Adulteration of Food and Drugs Act," which was passed during that year.

Whilst still a school-boy he developed scientific tastes and aptitudes, his hobby being chemistry; and, had he been born into a later generation, chemistry

is probably the science to which he would have devoted himself. But in those days chemistry was not a very definite calling and he took up medicine as being, of the then recognised professions, the one most congenial to the student allured by the fascination of natural science.

He passed the examinations of the Royal College of Surgeons and of the Society of Apothecaries at an early date and took his doctorate in medicine at Aberdeen in 1854. But, before then, he had found time for more than one sojourn at Freiburg (studying blow-pipe analysis), and had managed to put in some work with St. Clair Deville in Paris.

He was appointed lecturer on chemistry at Sydenham College (Birmingham) on its foundation in 1853. This College was subsequently amalgamated with Queen's College in which he then became professor of chemistry—a post which he continued to occupy until 1876.

During the greater part of his working life he filled the responsible position of Medical Officer of Health for Birmingham and thus became primarily occupied with sanitary science and he was the author of many papers on such questions as water supply, drainage, mines, housing, notification of infectious diseases and other cognate matters.

His duty as Public Analyst for Birmingham (and during some years for Warwick) kept him at the same time in touch with chemical matters, and some of his early work in connection with the adulteration of tea helped to pave the way to the systematic government examination of tea in bond, which continues to the present day.

The first volume of the ANALYST (1877) contains papers by him on "Milk Standards" and on "Milk of Sulphur," and to a subsequent volume (1881) he contributed two communications on the "Estimation of Tannin in Tea." To the ANALYST of 1885 he contributed a paper on "Sewage Farm Milk and Butter," and the volume of 1888 contains an interesting paper and discussion initiated by him on "Polluted Drinking Water and the Closure of Wells."

In 1885 he was elected President of the Society of Public Analysts, in succession to G. W. Wigner (who died before the completion of his term of office), and he had also been President of the Incorporated Society of Medical Officers of Health.

He served on the Council of the Institute of Chemistry from 1882 to 1885.

Next to chemistry, his favourite scientific pursuit was botany, and a ramble in the country with him was interesting. In early life he was an active sportsman, excelling in boxing and being keen on cricket. It may have been hereditary, or it may have been paternal, influence—or perhaps both—that led to two of his sons distinguishing themselves as county cricketers.

He gave up active professional work in 1903, at the age of seventy-six, and retired to the Isle of Wight where he enjoyed perfect health and preserved his physical and full mental vigour until beyond his ninety-fifth birthday, dying finally, painlessly and peacefully, of mere old age, without any other disease or disorder.

Those who, like the writer of this notice, had the privilege of enjoying his friendship, will not easily forget the amiability, courtliness and general charm which formed a fitting accompaniment of the inner qualities that endeared him to those who knew him; and the mental picture of his rarely handsome face and figure will not easily fade.

He left three sons, Dr. Bostock Hill, Dr. Eustace Hill and Mr. J. Ernest Hill.

BERNARD DYER.

The Testing of Foodstuffs for Vitamins.

BY J. C. DRUMMOND, D.Sc., F.I.C., AND A. F. WATSON, M.Sc., A.I.C.

(*Read at the Meeting, November* 2, 1921.)

THE advances which have been made in the field of vitamin research since Hopkins first described these substances (*J. Physiol.*, 1912, **44**, 425), only ten years ago, have been so rapid that to-day it may be said that the testing of foodstuffs for these important dietary principles may soon become part of the everyday work of the food chemist.

This aspect of food chemistry is of very great importance to Public Analysts, and the present paper has been brought forward to point out to them how foodstuffs are tested for vitamins at the present time, and to describe a few of the more important discoveries in this field, with their bearing on food in its relation to public health.

For those who wish to read an accurate summary of our knowledge concerning these remarkable substances, the official report of the Accessory Food Factors Committee of the Medical Research Council is recommended (Report No. 38, H.M. Stationery Office, 1919).*

Unfortunately, there are, at present, no chemical or physical methods available for the detection or estimation of these substances in foods, and we are obliged to utilise biological methods. It is, therefore, not surprising that the technique at present employed is liable to the errors associated with this type of test, and which are largely introduced by the individual variations of the test animals. In recent years, however, whilst unabating efforts to devise chemical or physical methods capable of accuracy have been made, the technique of conducting the feeding tests has been greatly improved so as to reduce these errors very considerably.

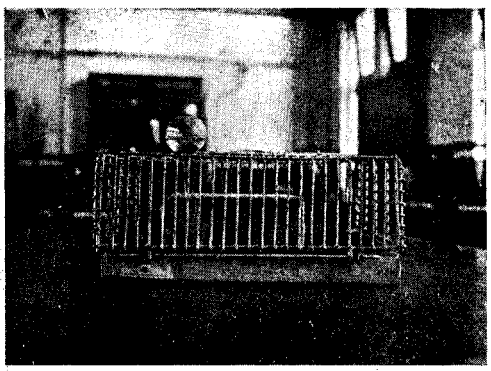
In the first place, it must be borne in mind that, to carry out a large number of routine vitamin tests of this nature, great care and attention must be devoted to the organisation of the laboratory for feeding experiments.

A special room or animal house must be available, and should be airy, light, and well ventilated, and, preferably, with walls and floors which may be washed

* This report is now slightly out of date owing to the rapid advance of knowledge of this subject. A new edition is being prepared by the Committee.

down or disinfected. Means of heating the room should be installed, for it is of primary importance to keep the experimental animals warm in cold weather.

For the majority of vitamin tests carried out in this laboratory rats are employed. The advantages of this species for the work have been alluded to many times by various workers (*cf.* Osborne and Mendel, "Experiments with Isolated Food Substances," Carnegie Publication, 156, 1911). Briefly stated, these are that the rat is cheap, easy to breed and rear, matures early, and has a life span of only two to three years. Further, it is omnivorous and will consume many substances which would be unpalatable to other species, whilst its food consumption is not high, a fact of no little importance when the high cost of preparing the purified basal dietary is considered. Moreover, the rat rapidly responds to a change in the nutritive value of the diet.



The animals are kept in small wire cages, 12 in. by 12 in. (see Figure), which are arranged in rows on racks constructed from ordinary gas piping.

The dimensions of the cage are 12 in. by 12 in. by 4 in. A galvanised iron tray containing a layer of sawdust $\frac{1}{2}$-inch deep is placed at the bottom, and a small wooden nest-box is provided to ensure a place free from cross draughts. By releasing the pin the top may be raised to feed or handle the animal. A glass automatic drinking device hangs through the bar.*

It is preferable to utilise home-bred stock for feeding experiments, and no great difficulties are presented by this task, if care is taken to select good breeding animals, to house them warmly, and feed them well.

THE TESTING OF FOODS FOR VITAMIN *A*.—The technique for this testing has been briefly described by Drummond and Coward (*Biochem. J.*, 1920, **14**, 661).

The first step is to feed young healthy rats of not more than 50 grms. body weight on a ration of purified foodstuffs from which all traces of the vitamin *A* have been removed.

This ration is compounded as given below:—

	Parts
Caseinogen	20
Rice starch	50
Commercial yeast extract	5
Salt mixture	5
Lemon juice	5
Hardened refined vegetable oil ..	15

* These cages, which are cheap and convenient, may be obtained from Messrs. Mantica, Essex Road, London, N.E.

Of the constituents of this mixture, only one, namely, the caseinogen, is liable to be contaminated with traces of vitamin *A*, the commercial samples usually containing this impurity associated with the traces of milk fat retained by the protein. Formerly it was necessary to submit the components of artificial diets to lengthy and costly extraction with alcohol and ether, in order to purify them from the associated growth-promoting factor, but this procedure is no longer necessary now that we know that this substance, whatever its nature, is readily destroyed by oxidation. Accordingly, the commercial caseinogen is now submitted to an oxidation in which the protein is spread out in thin layers and exposed to a temperature of 110° C. for several hours in a current of air.*

The composition of the inorganic salt mixture is essentially that described by McCollum and Davis (*J. Biol. Chem.*, 1915, **20**, 161):—

	Grms.
Sodium chloride	5·2
Magnesium sulphate	8·0
Sodium dihydrogen phosphate	10·4
Dipotassium hydrogen phosphate	28·6
Calcium superphosphate, $CaH_4(PO_4)_2$	16·2
Calcium lactate	39·0
Ferric citrate	3·5
Potassium iodide	Trace.
Manganese sulphate	,,

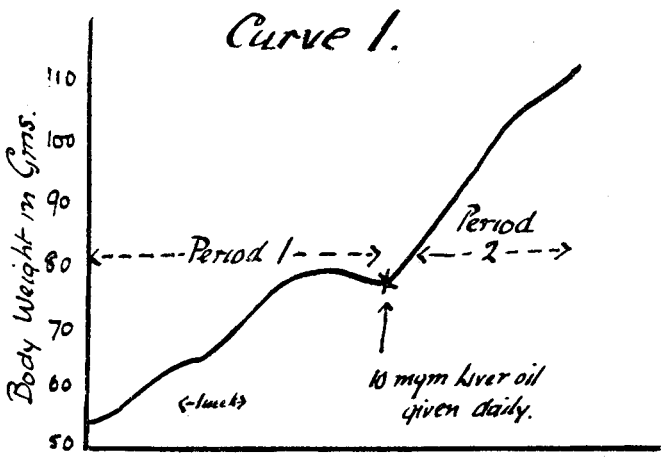
This mixture must be compounded from the pure salts. The yeast extract (marmite) and the lemon juice supply the other two accessory factors, and do not contain any detectable traces of vitamin *A*, whilst the hardened fat (usually cottonseed or linseed) is equally pure in this respect.

We have, on more than one occasion, drawn attention to the importance of selecting a source of fat devoid of the vitamin *A* for the basal ration (*cf.* Drummond and Coward, *Biochem. J.*, 1920, **14**, 661), for many failures to get clear-cut results are to be attributed to the inclusion of fats of which the vitamin content may be uncertain. For this reason we refuse to use any untreated fat, such as lard (*cf.* references to technique in the *Vitamin Manual*, Eddy, 1921, Baltimore).

It is important to start the test animals on the basal diet before they are heavier than 70 grms. Young rats fed on this ration usually grow for a few days, presumably while they are utilising the vitamin *A* reserves present in their own bodies, but soon show a retardation and cessation of growth (Period 1, Curve 1) When they have shown no further increment of weight over a period of 14 days they may be considered fit for vitamin tests. It is of the greatest importance to be sure that the rats show this satisfactory phase of no growth before testing is begun. The substance to be tested is then administered in a daily ration of known weight. The supplement is always given to the animals before they receive their daily ration of food, so as to ensure that it is eaten. In the very few cases in which the nature of the supplement renders it unpalatable, it is necessary to

* The British Drug Houses now prepare this purified caseinogen for utilisation in vitamin tests.

incorporate it with a little of the basal diet before it will be consumed, and, with a little pains, all such difficulties may be surmounted. The value of the supplement as a source of vitamin *A* is judged from the changes in body weight of the animals which follow its administration. In Period 2, Curve 1, is shown the sharp recovery



which follows the administration of a highly potent source of vitamin *A*, viz. 0·05 grm. daily of raw cod-liver oil.

By varying the "dosage" it is possible to compare, with a fair degree of accuracy, the value of a series of foodstuffs.*

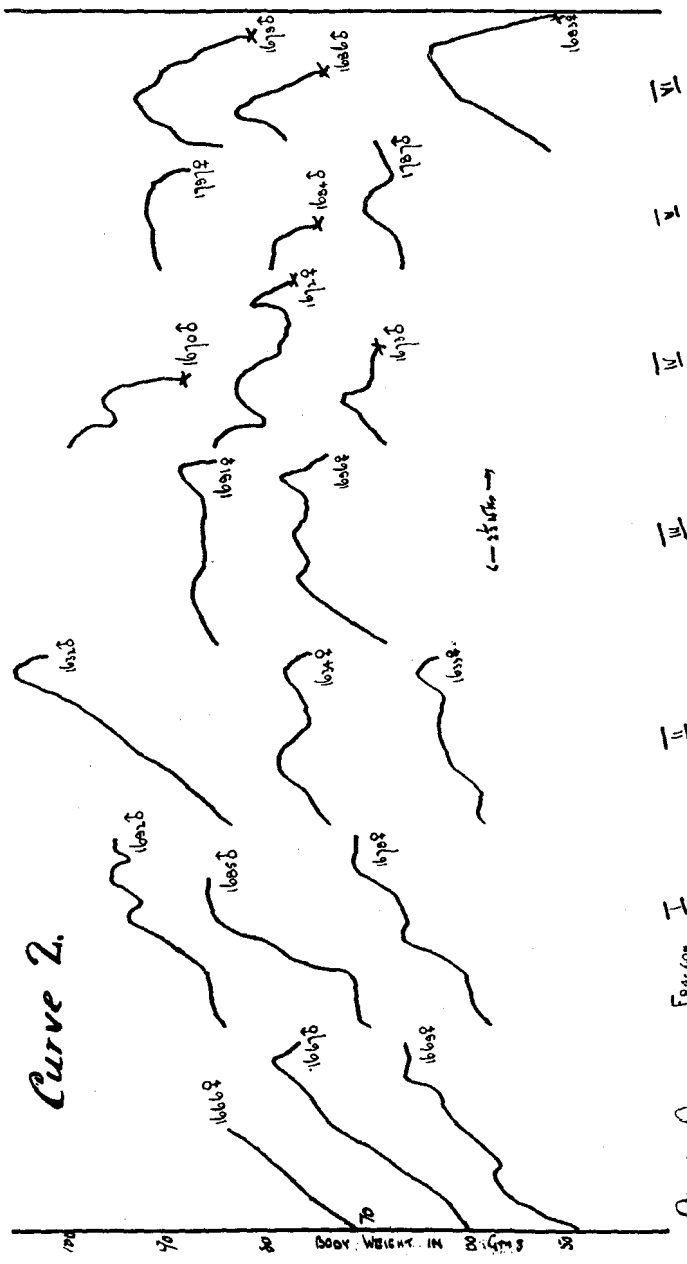
Curve 2 shows the falling off of growth-promoting powers as the vitamin *A* present in a sample of coal-fish oil (liver oil) is destroyed by oxidation at high temperatures.

That this method may, in the hands of skilled persons, be capable of a useful degree of accuracy is well shown by a recent series of tests which one of us (J. C. D.) is carrying out in collaboration with Dr. S. S. Zilva, of the Lister Institute. Almost identical results were obtained in the two laboratories on the same samples of oil by following closely the same technique.

Very occasionally, as in the case of certain plant tissues, for example, the material to be tested contains constituents which are toxic to rats. In such cases it is useless to attempt direct administration, and we have found that the best course is to prepare from the material that fraction which resists saponification by alkalis. This fraction, if prepared under conditions which exclude oxidation, will contain all the vitamin *A* present in the original material. Such a procedure is, however, laborious, and, fortunately, not frequently necessary.

By employing such a technique as outlined above it has been possible to gain much important information concerning vitamin *A* in foodstuffs, of which the

* Some remarkably fine quantitative results are shown in a recent paper by Zilva and Miura (*Biochem. J.*, 1921, **15**, 654). They were obtained by a refinement of the method of measuring and administering the supplements to be tested.



These series of curves show the loss of growth-promoting power in a sample of coal-fish liver oil during aeration at 100° C. The preparatory period illustrating the initial growth and following cessations on the basal diet is in each case omitted for simplicity. The curves illustrate only the effect of the supplement of oil (3 rats in each case). Complete inactivation appears to occur between 2 and 3 hours. Dose in each case 7·0 mgrms. per day of oil.

following examples are chosen as being of particular interest to Public Analysts:—

The superior nutritive value of butter and cod-liver oil to that of other fats was early shown to be due to the presence of vitamin *A*, but, more recently, it has been found that samples of butter may vary very considerably in the amount of vitamin they contain. The vitamin is apparently synthesised by the actively assimilating green leaves of plants (Coward and Drummond, *Biochem. J.*, 1921, **15**, 530), and from that source passes into the tissues of animals. The vitamin content of butter may therefore depend very largely on the diet of the cow, and interesting experimental data on this point have been presented by Drummond, Coward and Watson (*Biochem. J.*, 1921, **15**, 540).

The significance of the vitamin question in determining the food value of butters and butter substitutes must be taken into account, for it is very far reaching. The majority of the important vegetable oils and the raw products from which they are derived have recently been examined by Dr. Zilva and one of us (J. C. D.) (*J. Soc. Chem. Ind.*, 1922), with the result that the earlier conclusions of Halliburton and Drummond (*J. Physiol.*, 1917, **51**, 235) have been confirmed. All these oils appear to be very much lower in vitamin *A* content than the average samples of animal oils and fats, but, as pointed out above, the latter vary considerably with the diet of the animal (Drummond and Coward, *Biochem. J.*, 1920, **14**, 668). This relationship has been emphasised by us in the case of lard (Drummond, Golding, Zilva and Coward, *Biochem. J.*, 1920, **14**, 742).

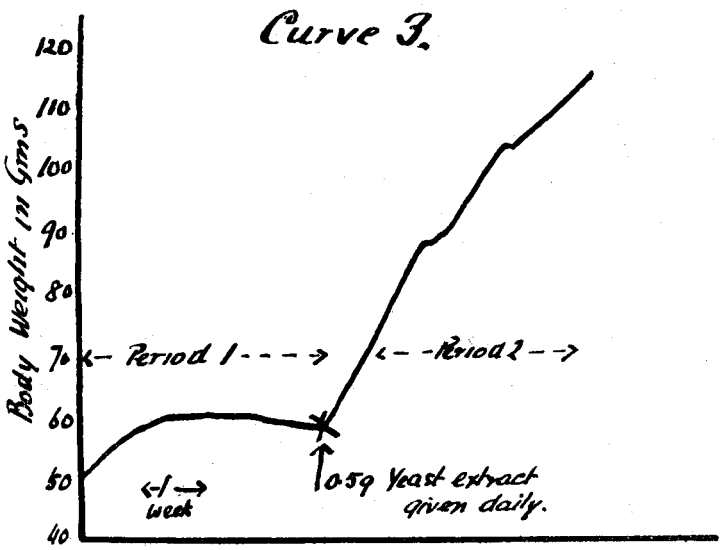
Of the other animal fats employed for margarine manufacture, oleo-oil also shows marked variation. A number of samples from N. America and the Argentine show a varying vitamin *A* content, which, from a study of the associated pigments and other evidence, appears to be a seasonal one, dependent on the state of the pasturage.

One important source of vitamin *A*, namely, cod-liver oil, is now being exhaustively studied by one of us (J. C. D.) in collaboration with Dr. S. S. Zilva. The extraordinary potency of this oil is well shown by the striking experiments of Zilva and Miura (*Lancet*, 1921, I., 323), who have shown that a daily ration of the order of 2 to 5 mgrms. is sufficient to produce nearly normal growth in a rat. When this is compared with the dose of an average sample of butter required to give the same result (from 0·2 to 0·4 grm.), the extraordinary efficacy of cod-liver oil is appreciated. It has recently been shown by Zilva and Drummond (*Lancet*, 1921, II., 753) that other fish-liver oils may be of the same order of potency. To appreciate the minute amount of the physiologically active principle which is effective in stimulating growth, it is only necessary to consider that the whole of the vitamin *A* is present in the unsaponifiable matter of the oil. Taking the larger figure for the "dosage" of oil (5 mgrms.) and the approximate value for the unsaponifiable matter as 2 per cent., we find the activity of the oil is wholly in the 0·1 mgrm. of this fraction, of which probably 90 per cent. is composed of cholesterol, which is known to be inactive, leaving the remaining 0·01 mgrm. as the source of the active substance.

THE TESTING OF FOODS FOR VITAMIN *B*.—The technique in this case is closely parallel to that described in the previous section. The basal diet is, however, one from which the vitamin *B* has been excluded. The composition of the mixture used in this laboratory is as follows:—

	Parts
Purified caseinogen (preferably alcohol-extracted) ..	20
Rice starch	55
Butter fat	15
Salt mixture	5
Orange juice	5

On such a diet the young rats quickly cease growing, there being apparently little or no reserve supplies which may be mobilised from the tissues (Curve 3, Period 1). After they have been stationary in weight for at least 14 days they



are ready for use. The supplement to be tested should be administered before the daily ration of basal diet, and there is seldom, if ever, any need to prepare an extract from the foodstuff under examination. The response in this test is very sharp (Curve 3, Period 2), and there is scarcely ever any doubt in interpreting the result.

Some investigators prefer to use the pigeon as a test animal for the vitamin *B*, taking, as the proof of its presence, the curative effect of the supplement on the pathological condition, termed incorrectly "avian polyneuritis," induced by a diet of polished rice. In our opinion, this method is very much less reliable than the tests on rats, which we find respond in a very sensitive manner to small supplements of foodstuffs containing vitamin *B*. By some, indeed, it has been questioned whether the same dietary factor is involved in the two cases, although the opinion of the chief workers in this country tends to regard them as identical (see *M. R. C. Report*).

More recently, in an attempt to introduce methods of estimating the vitamin content of foods which should be capable of a greater degree of accuracy than the animal-feeding tests, a number of American workers have turned their attention to the growth of yeast in pure cultures.

It may be remembered that, some years ago, Wilders, of Louvain, found that, to ensure the satisfactory growth of yeast cells in pure culture, a small amount of an organic complex, termed by him "bios," was necessary. Williams, in America, drew a parallel between "bios" and vitamin *B*, and, after investigation, suggested that the growth of yeast in artificial culture solutions might be standardised by extracts containing vitamin *B* (*J. Biol. Chem.*, 1919, **38**, 465; 1920, **42**, 259; 1921, **46**, 113).

At first the suggestion appeared most promising, and there are still investigators who advocate its use (Funk and Dubin, *J. Biol. Chem.*, 1920, **44**, 487; Bachmann, *J. Biol. Chem.*, 1919, **39**, 235), but the general tendency is to regard the method as unreliable, for the reason that the factors governing the rate of growth of yeast in such a test, in which miscellaneous extracts containing many constituents other than vitamin are added to the cultures, are very complex. This view has been strengthened by the discovery that yeast in pure culture can synthesise vitamin *B* (Nelson, Fulmer and Cessna, *J. Biol. Chem.*, 1921, **46**, 77; Harden and Zilva, *Biochem. J.*, 1921, **15**, 438).

Of the many interesting results concerning vitamin *B* which have recently been obtained, and which are of especial interest to Public Analysts, are those which show that the amount of vitamin *B* in milk depends entirely on the food of the cow (Dutcher, Kennedy and Eccles, *Science*, 1920, **52**, 588), and the observations that many commercial yeast extracts are almost the richest sources of the *B* factor which are available as foodstuffs. The latter point is of interest, when it is remembered that it is usual to test meat extracts for adulteration with yeast extracts. In future, it may be that adulteration of the more highly nutritive yeast extracts with less potent materials may be feared.

TESTING FOR VITAMIN *C*.—The testing for vitamin *C* presents more difficulties than either of the previous two techniques. This is due to the fact that the only two species of animal known to be suitable for the work are the guinea pig and the monkey. The latter is undoubtedly the ideal test animal, but it has the disadvantage of being very expensive. Moreover, it requires special housing and handling, and is somewhat delicate in this country. It also takes much longer to obtain a result with a monkey than with a guinea pig. The technique used with monkeys has been described by Harden and Zilva (*J. Path. and Bact.*, 1919, **22**, 246).

In most laboratories, however, guinea pigs are the only animals available, but this species also has its limitations. The guinea pig is entirely herbivorous, and normally consumes a bulky diet, largely composed of roots and leaves, for which its alimentary tract is especially suited. Many foodstuffs which it is wished to test for the antiscorbutic vitamin are such that they are not well tolerated by the digestive system of this animal, and it is frequently difficult to prepare the

food or an extract in a form which will be consumed and absorbed. This is particularly true when foodstuffs containing much fat, or when products of a sticky nature, as, for example, certain types of proprietary vitamin preparations, are to be tested.

The actual testing can be done either by determining the dose of foodstuff which will prevent the onset of the disease, or that necessary to effect a cure. By either method comparative figures are obtained. The basal diet which is usually employed to induce the scorbutic conditions is that originally used by Holst and Frohlich (*Zeitsch. Hyg. und Infektionsk.*, 1912, **72**, 1), consisting of bran and oats. Improved modifications of this diet have been proposed by other workers, that employed by Chick, Hume and Skelton (*Biochem. J.*, 1918, **12**, 131), in which the oats and bran are supplemented by autoclaved milk, being very good. More recently, American workers have employed more complex rations, such as that of La Mer, Campbell and Sherman (*Dissert.*, Columbia Univ., 1921), whose basal mixture is compounded as follows:—

	Per Cent.
Skim milk powder heated in air to 110°C. for two hours	30
Butter fat	10
Ground whole oats	59
Sodium chloride	1

These workers claim that their results have a high degree of accuracy for this type of test.

The potency of the food supplement added is judged from the "dosage" necessary to prevent the onset of, or to cure established scurvy, as proved by the subsequent post-mortem examination. This method has been used with success in the testing of milk and milk products, and in estimating the anti-scorbutic value of fruit juices and other commercial extracts.

Amongst the many interesting results obtained may be mentioned the discovery that the antiscorbutic value of the milk is dependent on the diet of the animals, and the fact that lemon juice possesses a very much higher antiscorbutic potency than lime juice (Chick, Hume and Skelton, *Lancet*, 1918, II., 735).

Conclusions.—In conclusion we would again emphasise the point that the opening up of this wide new field of food chemistry is of considerable importance to the Public Analyst, and we may briefly specify one or two examples.

Much of the work in this branch will deal with dairy products, since it is now no longer possible to be satisfied with the ordinary routine chemical analysis of a sample of milk or butter, if the information as to the true food value of these products is desired. Indeed, it is not at all improbable that certain aspects of the relationships of butter to butter substitutes may be greatly changed within the next few years, although it is yet too early to indicate the lines along which these changes may be made.

The control of the vitamin value of antiscorbutic material for the artificial feeding of infants, for supply to ships or for polar or other exploration parties will sooner or later be a task which certain Public Analysts must be prepared to

undertake, whilst an active branch of their work will possibly be concerned with the routine examination of proprietary foodstuffs whether for human or animal consumption, of which so many have already appeared on the market. Of such products which we have from time to time examined a number are genuine, in that they do actually contain the three known vitamins. Where most, in fact nearly all of them fail, is in their claims to supply these food factors in a highly concentrated form. On the other hand, several preparations are quite fraudulent, being found to be inactive from a vitamin standpoint when tested.

A certain, and by no means small, proportion of the public always buy such articles for themselves, their children, or their farm animals, and there is opening a wide and promising field for the quack unless such preparations are guaranteed by controlled tests.

The importance of tests for vitamins is so far recognised by certain firms of high standing that more than one have established special biological testing stations where they may submit their preparations to periodical testing, and also carry out research in order to improve the food value of their products.

THE BIOCHEMICAL LABORATORIES,
INSTITUTE OF PHYSIOLOGY,
UNIVERSITY COLLEGE, LONDON.

DISCUSSION.

The PRESIDENT (Mr. A. Smetham) said that he was interested in the nutritive values of margarine and butter, and would like to know what became of the fats in the case of margarine, if they did not contain these vitamins. As they were digested, why did they not have a nutritive effect on the body?

Mr. A. E. PARKES hoped that the authors would bring forward some chemical methods of determining the presence of vitamins. He thought that vitamins must have some function in plants, and presumed it had something to do with growth. The question was: Were they of the nature of enzymes? He was much interested in the experiments with cows at different times of the year, and asked whether the question of the vitamins in hay had ever been discussed; had, for instance, the drying of hay the effect of destroying or preserving the vitamins?

Mr. C. A. MITCHELL said that enzymes apparently resembled vitamins in being a peculiar form of energy attached to a material substance associated with life, but the difference appeared to be that, whereas enzymes exerted a specific chemical action, the activity of vitamins appeared to be directed to the stimulation of a sum of chemical actions in vital processes. Following this line of thought, he enquired whether any experiments had ever been made to see whether the activity of individual enzymes could be stimulated *in vitro* by different vitamins. If, for example, the action of lipase were increased by the fat-soluble vitamin, a measure of vitaminic activity might be based on the differences in the lipolytic action with and without the presence of the vitamin. The recent work of Beszenoff, showing that certain vitaminic substances were associated with a substance of a

phenolic character would, if corroborated, mark an advance towards a chemical method of identification of, at all events, one of the vitamins.

Mr. E. HINKS said that he would be glad to know where the methods of preparing vitamin-free basal rations were recorded, and asked if any thing were known as to the effect of an excess of vitamins.

Mr. BOLTON drew attention to the experiment which the authors had demonstrated, with such marked effect, with mgrms. of cod-liver oil. He said that when one considered that there must have been 99 per cent. of glycerides and also unsaponifiable matter, all in the two mgrms., the actual weight of vitamins present was so small as to be hardly realisable. He deprecated the use of strong sulphuric acid as a distinguishing agent, in view of the striking colours it gave with so many organic substances. In his opinion the exact part played by (*a*) temperature, and (*b*) oxidation, in the destruction of vitamins was a matter of extreme importance, requiring particular investigation. Recent experiments seemed to show that oxidation was the main destructive factor, and that temperature played a far less important part.

Mr. COLLETT enquired whether the authors had ever tried any experiments on reducing the quantity of vitamins in these foods, to see if thereby they could acclimatise the animals to the complete absence of these growth-promoting factors.

Dr. MONIER-WILLIAMS asked whether the substance discovered by Professor Hopkins had ever been tried on rats.

Dr. J. A. VOELCKER remarked that it was quite clear that vitamins were going to play an important part in food examination, but it was a terrible thought that one might have to go on weighing the animals, to see if the vitamins had had any effect or not. It would be comparable, for instance, with milking a cow to see how the animal was getting on, instead of for the purpose for which cows were sent into the world. Knowledge was wanted as to the cause of the influences which destroyed the activity of vitamins. He asked whether the cooking of food, such as, for instance, the heating or sterilising of milk, had a destructive influence on vitamins. These were all factors which bore, not so much on animals, as on human beings.

Dr. DRUMMOND, replying, said that the determining factor of the difference in the nutritive value of margarine and butter was the absence of vitamin *A* from some margarines. Vegetable fats were very low in the scale in this particular vitamin, but this was not the case with most animal fats. As to digestibility, the majority of ordinary edible fats were equally well digested, but fats such as cod-liver oil and butter were merely carriers of the vitamin. With regard to the possibility of these substances being enzymes, he thought the available evidence was all against this view. As regards the milk from London cows, he knew cases of special cows which were fed for high milk production on a low vitamin diet, with the result that they gave a very large volume of milk, although the nutritive value of the milk was not so good as that from many cows fed on grass and living in the open air. He had no knowledge as to whether hay lost or retained its vitamins. As to Mr. Hinks' question of the vitamin-free basal

ration, full details would be given in the published paper, or might be obtained from the Medical Research Council's Report, which anyone might buy. Regarding an excess of vitamins, the cow appeared to store up in her body reserves of vitamin *A*, which she was able to call upon when desired. He agreed that the sulphuric acid test was not one upon which one could place much reliance. As to the hydrogenation of fats, it would appear that the substance was destroyed by reduction as well as by oxidation. He was not aware of any laboratory experiments that would answer Mr. Collett's question. There was little definite information available upon the cooking of foodstuffs, and the literature on the subject was somewhat confused, but it was now generally believed that relatively little damage to vitamin occurred in the usual processes. So far as he was aware, no work had been done on the lines suggested by Mr. Mitchell. The suggestion might be made the subject of an interesting series of experiments.

The Constants of Indian Beeswax.

By O. D. ROBERTS, F.I.C., and H. T. ISLIP, A.I.C.

(*Read at the Meeting, April* 5, 1922.)

Four samples of beeswax from India were forwarded to the Imperial Institute for examination in 1917. The results of the investigation showed that one of these samples was much adulterated with paraffin wax, but, although the characters of the remaining samples differed considerably from those usually accepted for Indian beeswax, no definite indication of their adulteration could be obtained.

It was therefore suggested to the Director-General of Commercial Intelligence, Calcutta, that a comprehensive series of authentic samples of Indian beeswax should be collected from different districts and sent to the Imperial Institute for examination, in order that the constants of the pure Indian wax might be definitely established.

As a result of this enquiry a number of samples of honeycomb and wax, collected under the supervision of District Officers, were received in 1919 from the provinces of Bengal, and Eastern Bengal and Assam, and the results of their examination form the subject of this paper.

The following table gives the district in India from which the sample was collected, description of sample as received, and the yield and appearance of purified wax derived from it. The pure wax was obtained from the samples of honeycomb by melting them in boiling water and straining through calico. The partially purified wax so produced was boiled several times with water to remove all soluble impurities, and was separated, filtered, and dried at 100° C. The samples of wax were purified in the same way, except that the preliminary straining through calico was omitted:—

TABLE I.

Sample No.	District from which sample was collected	Description of sample as received	Yield of purified wax from samples as received Per Cent.	Description of purified wax.
1.	Cachar (Eastern Bengal & Assam).	A small cake of clean pale yellow wax, with a very faint odour of honey.	98·2	Almost white.
2.	Ditto.	A large cake of clean yellow wax, with a fairly strong odour of honey.	99·1	Bright pale yellow.
3.	Ditto.	A cake of clean yellow wax, with a slight odour of honey.	98·6	Very bright yellow.
4.	Ditto.	Balls (3·5″ diam.) and cubes (3·5″ sides) of pale coloured wax of dull appearance.	82	Dull yellow.
5.	Sylhet (Eastern Bengal & Assam).	Balls and lumps of sticky, brown, crude wax, from 1″ to 2·5″ diam., having a strong sugary odour.	47	Very pale yellow.
6.	Ditto.	Lumps of pale, rather sticky wax, 1″ to 3·5″ long and 1″–2″ broad.	80	Bright yellow.
7.	Ditto.	Balls of pressed honeycomb 1″ to 2·8″ diam. light yellow to dark brown in colour.	44	Pale orange.
8.	Goalpara (Eastern Bengal & Assam).	Dark brown honeycomb containing a good many dead bees.	36	Dirty brownish yellow.
9.	Ditto.	A thin flat sheet of dark brown honeycomb, 0·5″ by 10″ by 6″.	11	Pale yellow.
10.	Ditto.	Dark brown pressed honeycomb in the form of lumps and powder. A large number of dead bees were present in the comb.	35	Dark yellow.
11.	Ditto.	Two lumps of dark brown pressed honeycomb, practically devoid of odour.	43	Pale yellow.
12.	Ditto.	Brown pressed honeycomb, with an odour of sugar.	18	Dark chocolate.
13.	Ditto.	A ball of dull wax, 2″ in diameter.	90	Pale yellowish buff.
14.	Ditto.	A ball of dark sticky wax 1·7″ in diameter.	70	Chocolate.
15.	Ditto.	Pressed comb, and a small lump of dark coloured wax.	40	Pale chocolate.
16.	Ditto.	Two large cakes of wax, of a dark brownish-yellow colour.	98·7	Dull yellow.
17.	Lakhimpur (Eastern Bengal and Assam).	Pieces of pale yellow honeycomb of good appearance with a rather rank odour.	80	Very bright yellow.
18.	Kamrup (Eastern Bengal & Assam).	Dark coloured pressed honeycomb, with an odour of sugar.	75	Very light in colour with a brown tint
19.	Khulna (Bengal).	Honeycomb with a slight sugary odour, containing a few dead bees and some larvae of the wax moth.	28	Dull yellow.
20.	Singhbhum (Bengal).	Honeycomb of fairly dark brown colour and devoid of odour. The comb contained a number of dead bees.	20	Pale yellow.
21.	Ditto.	Pieces of greyish-brown honeycomb about 10″ by 4″ in good condition.	16	Pale orange.
22.	Ditto.	A piece of brown honeycomb 14″ by 10·5″ by 1″ which had been attacked by the wax moth	27	Fairly bright yellow.
23.	Howrah (Bengal).	Small pieces of greyish-brown honeycomb, containing a large number of dead bees.	44	Pale buff-yellow.

TABLE II.

No.	Specific Gravity at 15/15°C.	Melting Point* °C.	Acid Value	Ester Value	Ratio :— Ester Value / Acid Value	Iodine Value†	Salamon and Seaber clouding test‡ °C.	Buisine Test§ Hydrocarbons Per Cent.	Weinwurm Test Appearance of solution obtained‖
1.	0·9649	60·4	3·9	95·3	24·4	7·7	53	10·7	Opaque. Became much thicker on standing.
2.	0·9570	60·6	5·7	92·9	16·3	5·5	56	8·6	Slight opalescence. On standing became less thick than No. 1.
3.	0·9621	61·1	7·1	87·4	12·3	6·2	62	11·3 (M.P.50°C.)	Opaque. On standing similar to No. 2.
4.	0·9566	61·8	6·4	91·9	14·4	6·5	58	10·6	Opaque. Very slight precipitate on standing.
5.	0·9626	61·4	2·6	90·2	34·7	8·1	56	15·7 (M.P.49·4°C.)	Opaque. On standing became thick, semi-solid, and pasty.
6.	0·9628	61·1	6·2	90·8	14·6	5·0	58	10·0 (M.P.51°C.)	Very slight opalescence. On standing fairly large precipitate obtained.
7.	0·9671	60·7	5·8	93·0	16·0	5·2	61	12·7 (M.P.50·6°C.)	Clear solution. On standing became opaque.
8.	0·9684	61·0	3·7	96·0	26·0	6·1	59	8·2	Slight opalescence, less than No. 2. On standing became similar to No. 2.
9.	0·9621	60·9	—	—	—	—	—	—	—
10.	0·9733	66·4	4·2	89·6	21·3	—	—	—	—
11.	0·9688	60·6	5·8	89·5	15·4	—	—	—	—
12.	0·9608	61·5	—	—	—	—	—	—	—
13.	0·9619	61·1	7·6	92·6	12·2	4·9	58	9·2 (M.P.49·5°C.)	Very slight opalescence. On standing similar to No. 4.
14.	0·9646	63·8	3·8	88·6	23·3	—	—	—	—
15.	0·9717	61·4	7·5	92·5	12·3	—	—	—	—
16.	0·9646	61·3	5·6	94·7	16·9	4·8	52	8·6 (M.P.53·5°C.)	Slight opalescence. On standing similar to No. 5, but much less thick.
17.	0·9675	60·8	5·6	94·1	16·8	5·0	60	9·5 (M.P.51°C.)	Opaque. On standing similar to No. 6.
18.	0·9657	61·4	5·3	93·2	17·6	5·7	57	10·1 (M.P.53·5°C.)	Very slight opalescence. Practically no change on standing.
19.	0·9689	61·4	6·5	94·9	14·6	4·5	60	6·9	Opaque. On standing similar to No. 6.
20.	0·9632	61·2	6·8	92·6	13·6	5·8	55	8·9	Similar to No. 8. On standing similar to No. 6.
21.	0·9711	60·7	5·1	93·0	18·2	5·4	Very indefinite about 49	9·4 (M.P.50·2°C.)	Opaque. On standing similar to No. 6.
22.	0·9555	60·8	6·7	89·0	13·3	5·6	60	12·9 (M.P.52·5°C.)	Very slight opalescence. On standing similar to No. 6.
23.	0·9682	60·7	6·0	91·0	15·2	5·6	55	8·9 (M.P.51·1°C.)	Very slight opalescence. On standing similar to No. 7.

* By the open tube method. † Hübl—17 hours. ‡ *J. Soc. Chem. Ind.*, 1915, p. 461.

§ *Monit. Scient.*, 1890, p. 1127. Mangold, *Chem. Zeit.*, 1891, p. 799.

‖ Lewkowitsch's *Chemical Technology and Analysis of Oils, Fats and Waxes*, Vol. II., Fifth Edition, 1914, p. 921.

Information concerning the species of bee producing the wax was unfortunately not available except in the case of six samples, concerning which the following statements were furnished:—Nos. 5 and ? 0. "Probably *Apis dorsata*"; No. 17, "*Apis dorsata*, bigger variety"; No. 21, "The common Indian bee"; No. 22, "Corresponding to the rock bee in England."

Specimens of bees obtained from samples Nos. 19, 20 and 23 were forwarded to the Imperial Bureau of Entomology, and were identified in each case as *Apis dorsata*, F.

In several cases the samples of honeycomb yielded relatively small amounts of purified wax, as some of the combs consisted largely of organic fibrous tissue, whilst others contained a considerable quantity of dead bees and honey. Many of the samples contained a fair amount of mineral matter. The results of the examination of the purified waxes from each sample are shown in Table II. on the opposite page.

For comparison with these figures constants of Indian beeswax as recorded by different observers are given in the following table:—

TABLE III.

Wax	Specific Gravity	Melting Point	Acid Value	Ester Value	Ratio:— Ester Value / Acid Value	Iodine Value	No. of samples examined	Authority
Apis florea	Determined for 3 samples only:—0·953 to 0·964	°C						
Max.		68	8·9	123·8	—	11·4	5	
Min.		63	6·1	80·8	—	6·0		
Mean		64·2	7·5	95·6	—	8·0		
Apis dorsata								
Max.		67	10·2	97·8	—	9·9	22	Hooper, *Agric.Ledger*, 1904, No. 7.
Min.		60	4·4	69·5	—	4·8		
Mean		63·1	7·0	89·4	—	6·7		
Apis indica								
Max.		64	8·8	95·9	—	9·2	6	
Min.		62	5·0	84·0	—	5·3		
Mean		63·2	6·8	89·6	—	7·4		
"Ghedda" Wax								
Max.	—	—	12·2	103·1	18·8	—	132	Buchner, *Chem.Centr.* 1913, 84 (2), 292.
Min.	—	—	5·3	75·1	7·4	—		
East India Beeswax	—	65	6·1	77·2	12·1	10	2	Buchner (quoted by Lewkowitsch, *Oils, Fats and Waxes*, II., p. 914).
	—	66	6·0	76·1	12·6	10		
East India Beeswax								
Max.	—	*	8·9	99·5	14·9	9·3	418	Berg. (Lewkowitsch, II., p. 914).
Min.	—	*	6·3	86·2	10·0	7·1		
Mean	—	63·0	7·0–7·5	89–94	12·5–13·5	8·5–8·7		
East India Beeswax								Schulten, *J. Soc. Chem. Ind.*, 1913, 32, p. 982, commercial samples of "pure wax."
Max.	—	—	6·7	—	15·1		24	
Min.	—	—	6·3	—	13·0			

* Both maximum and minimum are given by Lewkowitsch as 63·5°C.

The following remarks may be made regarding the constants of the present samples (see Table II.):

Samples No. 1 and No. 8.—The genuineness of these samples of wax was indicated by the normal percentage of hydrocarbons and the values of most of the other constants, but, otherwise, in view of their very low acid values, the samples would have been considered to be adulterated with paraffin wax.

Nos. 2, 3, 4, 6, 11, 13, 17, 18, 20, and 23.—The constants for these samples of wax agree approximately with those previously attributed to genuine Indian beeswax.

No. 5.—This wax had very abnormal constants, which differed considerably from those found for the remaining samples. Its extremely low acid value and correspondingly high ester-acid ratio, its high percentage of hydrocarbons, and the most decided result of Weinwurm's test, would all be generally regarded as definite proofs of adulteration with paraffin wax. There was, however, no corresponding lowering of the specific gravity and melting point, which were about normal.

No. 7.—This wax contained a rather high percentage of hydrocarbons.

Nos. 9 and 12.—These samples were too small to permit of complete examination.

No. 10.—This wax was rather abnormal, having a high specific gravity and melting point and low acid value. The sample was too small for complete examination.

No. 14.—This sample resembled No. 1 in having a very low acid value and correspondingly high ester-acid ratio. The sample was, however, too small for complete examination.

No. 15.—This wax had a somewhat high specific gravity, but otherwise the constants it was possible to obtain with the small amount of wax available were in fair agreement with those previously regarded as typical of genuine Indian beeswax.

Nos. 16 and 19.—The iodine value of these waxes was rather low.

No. 21.—This wax has a rather high specific gravity.

No. 22.—This sample contained a rather high percentage of hydrocarbons, and the specific gravity was rather low.

Apart from sample No. 5, which had very abnormal properties, and samples Nos. 9 and 12, which were too small for complete examination, the remaining samples examined had the following minimum, maximum and average constants:—

	Specific Gravity	Melting Point °C.	Acid Value	Ester Value	Ratio :— Ester Value / Acid Value	Iodine Value	Salamon and Seaber's Test	Hydrocarbons Per Cent.
Min.	0·9555	60·4	3·7	87·4	12·2	4·5	52	6·9
Max.	0·9733	66·4	7·6	96·0	26·0	7·7	62	12·9
Average	0·9652	61·4	5·8	92·1	16·7	5·6*	57·6†	9·8*

* Average of 16 samples only. † Average of 15 samples only.

An outstanding feature of the results obtained with these samples is the extremely low acid value, the figures in many cases being lower than that which has hitherto been regarded as representing unadulterated Indian beeswax, *i.e.* approximately 6.

It is clear also that Weinwurm's test is of no value for the detection of adulteration with paraffin wax in samples of Indian beeswax, for, with one exception (sample No. 7), the solutions obtained were more or less cloudy, whereas, according to Weinwurm, the solution should be transparent and clear if the wax is pure.

Salamon and Seaber's test is also shown to be untrustworthy in this connection. According to these workers, the "clouding point" is 56° C. for beeswaxes of the East Indian type, and the addition of 5 per cent. of paraffin wax raises the point from 56° C. to 61°–62° C., and 10 per cent. to 69°–70° C.

The results of this investigation are of considerable interest as indicating the variations which may occur in the constants of authentic samples of Indian beeswax. No comparison of the waxes obtained from the different species of bee occurring in India has been possible, as the information furnished in connection with the samples was very incomplete.

Discussion.

Dr. Dyer asked by what method the hydrocarbons were estimated.

Mr. R. G. Pelly said that the necessity for an investigation, such as the authors had carried out, arose some years ago, when a few samples of Indian beeswax were examined at the Imperial Institute, and it was found impossible to determine if these were free from adulterants. It also appeared probable that certain of the results previously recorded for Indian beeswax were unreliable. Accordingly steps were taken to obtain samples from carefully authenticated sources, and not at random from native bazaar merchants, and the results could, therefore, be accepted with confidence.

Mr. Roberts replied that the method of estimating the hydrocarbons was that devised by Buisine. It was carried out by heating a mixture of the saponified wax and potash-lime for about two to three hours at a temperature of about 250° C. This decomposed the alcoholic constituents and left the hydrocarbons, which were then extracted with petroleum spirit and weighed.

Inadequacy of "A.R." Test for Alkalis in Calcium Carbonate.

By WILLIAM SINGLETON and HOWELL WILLIAMS.

(*Read at the Meeting, May* 3, 1922.)

While recently investigating the composition of a series of glasses the authors were surprised to find that they were obtaining consistently high totals, varying from 107 to 108 per cent. Since the actual constituents of the samples were known, and the method of analysis employed had previously given satisfactory results, it seemed probable that the errors were due to impurities in the reagents, although these were all guaranteed to be of "A.R." quality (standard of purity regarded as necessary for analytical work by the special committee appointed by the Councils of the Institute of Chemistry and the Society of Public Analysts).

On examination of the reagents by the "A.R." methods it was found that the quantity of alkalis which could be removed from the calcium carbonate varied with the conditions under which the test was made, but the maximum which it was found possible to remove did not by any means account for the large discrepancies in the glass analyses. The test consists in boiling 5 grms. of the substance in 50 c.c. of water, filtering off 25 c.c., evaporating the filtrate to dryness, and igniting the residue. The residue should not weigh more than 1 mgrm. This test assumes that, since alkali carbonates are freely soluble in water and calcium carbonate is insoluble, a rapid and complete separation can be brought about in this manner. Experiments were, therefore, made to determine whether such a separation actually occurs. For this purpose 5 grm. portions of the substance were repeatedly extracted by boiling with water (50 c.c. portions) for 10 minutes, and the residue was then filtered off and washed with boiling water until free from alkalis, as indicated by a flame test. The alkalis were estimated by weighing the residue obtained by evaporating the filtrate and washings to dryness and gently igniting it. To avoid contamination, which might occur by using glass vessels, platinum vessels were used throughout. The results obtained in a series of experiments, which are tabulated below, represent mgrms. of alkali carbonates per 5 grms. of substance.

	(1)	(2)	(3)	(4)	(5)
1st extraction	9·3	9·4	11·8	15·4	10·0
2nd ,,	3·0	2·6	4·0	5·4	5·0
3rd ,,	1·7	1·7	4·0	3·6	3·0
4th ,,	1·6	1·7	2·6	3·6	3·0
5th ,,	1·6	1·7	2·0	1·6	2·0
Total	17·2	17·1	24·4	29·6	23·0

In the analysis of the total residues 0·1113 grm. residues gave 0·047 grm. of carbon dioxide (0·1113 grm. of Na_2CO_3 requires 0·0462 grm. CO_2). A qualitative examination of the residues showed that the only impurity present was a slight trace of potassium.

It will be seen from the above results that, even after five extractions of the substance with water, the alkalis are not completely removed, and that only about half of the total amount separated by five extractions is removed by the first treatment.

Since alkalis present in the calcium carbonate could not be estimated by merely extracting the substance with water, the Lawrence Smith method (*Amer. J. Sci.*, 1871, **50,** 269), which the authors had employed for the estimation of alkalis in the samples of glass, was used. Five grms. of the calcium carbonate was mixed with 0·5 grm. of ammonium chloride and heated to a dull red heat in a closed platinum thimble for about 1 hour. The mass was then extracted with water, the extract filtered, and the calcium in solution precipitated by means of ammonium carbonate and ammonium oxalate. The calcium-free solution was acidified with hydrochloric acid, and evaporated to dryness, and the residue ignited at a dull red heat and weighed. The following results were obtained in a series of experiments with the same specimen of calcium carbonate as that used in the water-extraction experiments, the amounts of sodium carbonate being calculated from the alkali chloride figures:—

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Alkali chloride, mgrms.	90·9	90·0	89·8	90·0	86·5	87·4	87·2
Sodium carbonate, mgrms.	118·2	117·0	116·7	117·0	112·5	113·6	113·3

A qualitative examination of the alkali chloride residues showed that they were almost pure sodium chloride, containing only a slight trace of potassium chloride.

A check on the Lawrence Smith method was made by decomposing 5 grms. of the calcium carbonate with hydrochloric acid, and precipitating the calcium twice with ammonium carbonate and ammonium oxalate. The solution, after evaporation to dryness and gentle ignition, left a residue of alkali chlorides weighing 88 mgrms.

Since only about 10 per cent. of the alkali carbonates present in the calcium carbonate are removed by one extraction with water, the "A.R." method is obviously inadequate, and requires revision. The difficulty of removing alkalis from precipitates by washing is well known, and the authors are of opinion that methods for the estimation of alkalis which depend upon their solubility in water are unreliable.

An investigation is now being made to determine the cause of the apparent insolubility of sodium carbonate in the presence of calcium carbonate. It is probable that during the precipitation of calcium carbonate from solutions containing alkalis, the latter form nuclei round which the calcium carbonate particles are formed, as it has been found that sodium carbonate can be almost completely

removed from pure calcium carbonate which has been boiled in a sodium carbonate solution, whilst the amount of "insoluble" sodium carbonate present in calcium carbonate which has been precipitated from sodium carbonate solutions increases with the concentration of the sodium carbonate.

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DISCUSSION.

Mr. F. H. CARR said that, though he was not prepared to defend all the "A.R." methods, there were great difficulties in connection with any method of determining alkalis which was dependent on the precipitation of calcium as oxalate or other insoluble salt, and on the removal of small amounts of sodium salts by washing. There was always calcium present in the residue and this had to be precipitated afresh, so that while the "A.R." test might be subject to error, the other methods which had been proposed were also unreliable.

Mr. T. T. COCKING said that the whole of the alkali did not go through into the filtrate on precipitating calcium—at best there was 95 per cent. of alkali; possibly the remainder would go through if washing were continued.

Note.

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

A SPURIOUS MALT VINEGAR.

A short time ago the Public Health authorities of a Northern Borough received from a firm of Vinegar Manufacturers a sample of malt vinegar; they were asked to state whether the sale of the sample as malt vinegar would be justified under the Sale of Food and Drugs Acts. The medical officer of health was informed that the sample had been made by dissolving 1 oz. of malt extract and $\frac{3}{4}$ oz. of burnt sugar in 1 gallon of water and adding $6\frac{1}{2}$ ozs. of glacial acetic acid B.P.; the sample was submitted to me for analysis, and the results will probably be interesting, in view of the possibility of this article being placed on the market. Specific gravity (at 15·5° C.), 1010·0; total solid matter, 1·04; ash, 0·05; alkalinity (as K_2O), 0·005; and phosphate (as P_2O_5), 0·02 per cent. The above results are, of course, widely divergent from those obtained with a genuine malt vinegar, but it is quite conceivable that a judicious increase in the ingredients might produce an article more closely resembling genuine malt vinegar. The sample submitted to me was easily distinguished by its taste and smell.

T. R. HODGSON.

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Notes from the Reports of Public Analysts.

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

ANNUAL REPORT OF THE BIRMINGHAM CITY ANALYST, 1921.

SALE OF FOODS AND DRUGS ACT.—During the year 4059 samples were examined, 505 of which were bought formally. Of these 4059 samples, 30 (0·7 per cent.) were adulterated with preservatives only, and 233 (5·8 per cent.) in other ways. The percentage of adulteration with preservatives was greater than in any year since 1912.

MILK.—The number of samples analysed was 2251, of which 208 were adulterated, and 110 samples of bottled milk were examined, of which 5 were adulterated. Four informal samples from one vendor contained 37 to 51 grains of boric acid, and 1 sample from another vendor 6 grains per gallon.

CREAM.—Eight samples of cream were free from boric acid; 7 contained 0·2 to 0·4 per cent. and 1 contained 0·9 per cent. Only 1 of 5 samples of preserved cream complied with regulation as to labelling.

LIQUID EGGS.—A sample of liquid egg yolk contained 1·8 per cent. of boric acid. Samples of "frozen egg" were free from that preservative.

NATIONAL HEALTH INSURANCE DISPENSING.—Fifteen prescriptions of panel doctors were taken to pharmacists to be dispensed. With one slight exception, the directions on the bottles were in accordance with the prescriptions. Five of the samples were not in accordance with the prescription, and the vendors of two of them (quinine mixture) were each fined £15 for the sale of preparations deficient in strength. In the case of formal mixtures the Inspector was requested to mark on the outside of the bottle the level of the top of the medicine and to forward the empty bottle with the sample. The contents were measured to the mark, and the constituents expressed on the Analyst's certificate as the quantities contained in that volume. This enabled the Magistrates to judge (*a*) if the proper amount of drugs had been put in the bottle, and (*b*) if the patient would get the proper amount of drugs in each dose.

CITRIC ACID.—Sixteen samples were genuine and free from excess of lead and arsenic. Two vendors were fined for the sale of tartaric acid as citric acid.

BORIC ACID OINTMENT.—An informal sample contained 8·3 instead of 10 per cent. of boric acid.

WATER DEPARTMENT.—During the year 506 samples were examined. Three samples of Corporation water taken from consumers' taps were examined each month. The average results for the year were as follows:—Total solids, 5·2; free ammonia, 0·000; albuminoid ammonia, 0·006; oxygen consumed in 3 hours at 27° C., 0·18; chlorine as chlorides, 0·8; hardness (as $CaCO_3$), 2·8; and alkalinity (as $CaCO_3$), 1·8 parts per 100,000. The tintometer reading in 2 ft. tube was: Red, 0·5; yellow, 2·9; blue, 0, on Lovibond's scale.

HOUSING AND ESTATES DEPARTMENT.—A large proportion of the 59 samples of paint examined was adulterated with chalk, barium sulphate, or zinc oxide. (See also Quarterly Reports, ANALYST, 1921, **46**, 452; 1922, **47**, 19, 167).

J. F. LIVERSEEGE.

METROPOLITAN BOROUGH OF STEPNEY.

PUBLIC ANALYST'S REPORT FOR THE FIRST QUARTER, 1922.

FOOD AND DRUGS ACTS.—Of 409 samples examined 261 were formally purchased. The total number found to be adulterated was 12.

MILK.—Two of the 238 samples were adulterated. The average composition of all the samples was: Fat, 3·57 to 3·70; solids not fat, 8·69 to 8·78 per cent.

PRESCRIPTIONS.—Eight trial prescriptions were dispensed under the National Health Insurance Act. In 3 cases the samples were unsatisfactory, and formal samples were then taken, and, as these were also adulterated, proceedings were instituted. These samples were as follows:—*Potassium bromide mixture* (deficiency of 38 per cent. of potassium bromide); *sodium salicylate mixture* (deficiency of 27 per cent. of sodium salicylate); *sodium salicylate mixture* (excess of 62 per cent. of sodium salicylate). A full report of the prosecutions in connection with prescriptions under the National Health Insurance Act was published in the *British Food Journal* (1922, **24**, 40). HERBERT HAWLEY.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH.

SAMPLING AND ANALYSIS OF COAL COMMITTEE.

The Fuel Research Board of the Department of Scientific and Industrial Research have appointed a Committee to advise upon the sampling and analysis of coal. The personnel of the Committee is as follows:—Professor Thomas Gray, D.Sc., Ph.D. (Chairman); Professor J. W. Cobb, C.B.E., B.Sc.; Mr. J. T. Dunn, D.Sc.; Mr. J. S. Flett, O.B.E., D.Sc., LL.D., F.R.S.; Mr. G. Nevill Huntly, B.Sc.; Mr. S. Roy Illingworth, M.Sc.; Mr. J. G. King, F.I.C.; Mr. C. H. Lander, D.Sc.; Mr. R. Lessing, Ph.D.; Mr. C. A. Seyler, B.Sc.; Mr. F. S. Sinnatt, M.B.E., M.Sc.; and Professor R. V. Wheeler, D.Sc. Secretary: Miss N. Renouf.

It is intended that the methods recommended by the Committee shall be adopted in connection with the Physical and Chemical Survey of the National Coal Resources.

Communications for the Committee should be addressed to the Secretary at 16 and 18, Old Queen Street, Westminster, London, S.W.1.

Meteorological Office, Air Ministry.

ADVISORY COMMITTEE ON ATMOSPHERIC POLLUTION.

REPORT ON OBSERVATIONS IN THE YEAR ENDING MARCH 31ST, 1921.*

During the year deposit from the air was measured at 31 stations, and the results are dissected in a series of tables; (1) Monthly deposit for two selected stations, typical of high and low deposits respectively, *i.e.* Birmingham (Central) and Rothamsted. (2) Total solids deposited monthly at all stations. (3) Mean monthly deposits for summer half years. (4) Mean monthly deposits for winter half years. (5) and (6) Classification of stations under Groups A, B, C, and D, according to amounts of pollution for same periods as in Nos. 3 and 4. (7) and (8) Totals of stations for each element of pollution, prepared from tables 5 and 6.

* [M.O. 249]. H.M. Stationery Office, Kingsway, W.C.2. Price 2s. net.

(9) Comparison of mean monthly deposit during summer and winter. (10) Average deposit of each element of pollution for a certain group of stations. Rochdale (with 24 metric tons per sq. kilometre) showed the highest mean monthly deposit, and Rothamsted (with 4·22 metric tons) the lowest. In comparison with the results for 1919–1920, there was a fairly general increase in the summer deposits, and a reduction in the winter deposits.

Birmingham (Central) heads the list for insoluble carbonaceous matter and ash, Newcastle coming next. The two lowest stations for these elements were Rothamsted and Southport.

The highest deposit of tar was in the Meteorological Office gauge, London; the next highest being in Newcastle-on-Tyne. The lowest deposit of tar was found in Birmingham (South Western) and in Southport (Hesketh Park), and Golden Lane, London.

Liverpool samples showed the highest deposit of soluble volatile matter, ash, sulphate, and chlorine, but it must be kept in mind that sulphates and chlorine are already included under soluble matter lost on ignition, so that it might be put better if we say that Liverpool showed the highest deposit of soluble matter.

Glasgow provided the second highest deposit of soluble loss on ignition and chlorine, and the highest and second highest of ammonia.

In four cases Rothamsted, which is an open agricultural district, showed the lowest and second lowest deposit; Birmingham (South Western) also ranks lowest or second lowest for four of the elements of pollution. Southport (Hesketh Park) is lowest or second lowest in five instances and London gauges give the lowest deposits in five cases.

Suspended Impurity in London.—Suspended impurities were measured by means of an automatic instrument, which filters a measured volume of air through a disc of white filter paper of definite size. Taking the available figures for May, 1920, and comparing these with May, 1921, and basing this on the average impurity between the hours of 9 a.m. and 5 p.m., we find in May, 1920, the average was 0·346 mgrm. per cb. m., whilst in May, 1921, it amounted to 0·227. During the month of November, 1920, the average impurity for the same hours amounted to 1·41 mgrm. per cb. m. The effect of suspended impurity on health is discussed, and it is shown by means of curves that there is a tendency for the death-rate to reach a maximum a little later than the maximum impurity.

The November Fogs of London.—A small jet of air was made to impinge upon a glass microscope slide, and the resulting dark patches of fog particles were examined under the microscope. They consisted of aggregates of particles which had coalesced, whilst there were also numerous individual particles varying in diameter from about 1/100,000th to about 1/20,000th of an inch.

The records of smoke fogs, taken during November, 1920, on the automatic fog recorder, show that such fogs may come on in about 3 to 4 hours. When the air in London is fairly clear in winter the amount of suspended matter is about 1 mgrm. per cb.m., but during a dense fog the quantity rises to about 5 mgrms. per cb.m. Taking the area at 120 sq. miles and the height at 400 ft., the weight of impurity suspended over London by such a fog corresponds approximately to 190 tons. It is estimated that the amount of smoke emitted in London during 4 hours of winter months would represent 176 tons.

Research Work on Measurement of Acidity.—A colorimetric method of measuring acidity in the suspended matter of the air has been found unsuitable, and a method of estimation by means of electrical conductivity has therefore been tried. This method has proved so extremely sensitive that it is necessary to use silica apparatus, the alkali dissolved in a few minutes from a glass vessel being sufficient to invalidate the results.

As a filtering medium of sufficient neutrality to be of use could not be discovered, an electrical method of collecting the suspended matter has been devised. By passing air over the surface of a very small quantity of conductivity water in a flat silica dish, the water being electrified statically by means of a Wimshurst machine, it is possible to collect the suspended matter from it without production of oxides of nitrogen, and to estimate the collected dirt by means of electrical conductivity.

The conductivity of the water is determined in the usual way, after the introduction of gold-plated electrodes constructed of long lengths of fine wire, and by this means the presence of the most minute quantity of electrolyte can be detected. For instance, simply touching the surface of the water with a glass rod cleaned in any ordinary way produces a distinct change in the resistance of the system.

There is definite indication that this method might be used for estimation of gaseous acid as well as suspended impurity, and the possibility of differentiating between these two forms of impurity by means of one piece of apparatus is being investigated.

Experimental difficulties in connection with any apparatus of this sensitiveness are great, but should it be possible to find a practical application of the method, it will afford a very rapid means of estimating electrolyte in the suspended matter of the air.

ABSTRACTS OF PAPERS PUBLISHED IN OTHER JOURNALS.

Food and Drugs Analysis.

Loss of Carbon Dioxide from Dough as an Index of Flour Strength. C. H. Bailey and M. Weigley. (*J. Ind. Eng. Chem.*, 1922, **14**, 147–150.)—The loss of carbon dioxide per unit increase in volume of dough under definite conditions affords a useful measure of the gas-holding capacity of the dough, and, consequently, of the strength of the flour. The following method was used for the estimation of the loss of carbon dioxide:—Two flours, one a "strong" flour from hard spring wheat and the other a "weak" flour from soft wheat, were made into doughs in a mechanical mixer (flour, 350 grms.; yeast, 4·25 grms.; salt, 5·25 grms.; sugar, 8·75 grms.; water, 56 c.c. per 100 grms. of weak flour and 61·4 c.c. per 100 grms. of strong flour). Two series of experiments were made with these doughs; in the first, the estimations were made on the dough directly from the mixer, whilst in the other series the dough was fermented at 28° C. for about four hours and then kneaded. In both series the doughs were divided into aliquot portions, each representing one-seventh of the total, or 50 grms., of flour; these were kneaded and moulded under similar conditions. One portion was placed in a measuring cylinder containing 600 c.c. of water, and its volume determined by the rise in level of the water; another portion was moulded into a cylindrical form and

placed in a dry 250 c.c. measuring cylinder, where its subsequent volume was noted as fermentation proceeded. A third portion was moulded into a shallow iron pan, 7 cm. in diameter and 1·8 cm. in depth; and this pan was then placed in a glass vessel (an inverted dialyser), which in turn was placed in an oven at 34° C. A current of air, free from carbon dioxide and heated at 34° C., was introduced into the top of the glass vessel, and the bottom of the latter was connected with an absorption vessel containing a definite volume of standardised barium hydroxide solution; this absorption vessel was changed every thirty minutes, and the residual barium hydroxide titrated, thus giving the amount of carbon dioxide evolved from the dough during each thirty minute period. The results obtained are given in the following table:—

	Strong Flour.			Weak Flour.		
	Time Min.	Carbon Dioxide Loss c.c.	Volume of Dough c.c.	Time Min.	Carbon Dioxide Loss c.c.	Volume of Dough c.c.
No previous fermentation.	0	—	63	0	—	63
	30	15·1	78	30	25·4	74
	60	29·6	113	60	46·3	101
	90	41·9	165	90	74·0	144
	120	56·6	203	120	113·0	183
	150	81·8	226	150	154·7	192
Fermented normally.	0	—	71	0	—	62
	30	27·4	145	30	31·0	128
	60	64·9	219	60	71·0	176
	90	101·6	254	90	133·5	189
	120	131·4	266	—	—	—

W. P. S.

Detection of Coconut Oil in Butter. C. F. Muttelet. (*Comptes rend.*, 1922, **174,** 220–223.)—The presence of 10 per cent. of coconut oil in butter may be rapidly detected by means of the phytosteryl acetate test. Fifty grms. of the filtered fatty acids (including unsaponifiable matter) from the butter fat are treated with 20 c.c. of a 1 per cent. solution of digitonin in 95 per cent. alcohol, and the mixture frequently stirred, and, after standing 30 to 45 minutes, heated and filtered. (The addition of 1 c.c. of water at an early stage promotes the separation of the digitonide.) The precipitate is washed with hot chloroform and then with cold ether, and dried. It is then boiled for five minutes with 2 to 4 c.c. of acetic anhydride, and the sterol acetate precipitated by the addition of 5 vols. of 50 per cent. alcohol and separated with the aid of a vacuum pump. The precipitate is dissolved off the filter with cold ether, the solution evaporated, and the residue recrystallised from 1 to 2 c.c. of absolute alcohol. The cholesteryl acetate thus separated from 15 samples of pure French butters melted at 113·6 to 114·2° C., whilst the phytosteryl acetate from coconut oil melted at 125° C. The mixed acetates from butter containing 5 per cent. of coconut oil melted at 115·5° C., and from that containing 20 per cent, at 116·6° C.

Glycerides of Goose Fat. A. Bömer and H. Merten. (*Zeitsch. Untersuch. Nahr. Genussm.*, 1922, **43**, 101–137.)—The specimen of goose fat used in the investigation melted at 36·7° C., and had iodine value 66·2, and saponification value 196·8. The fatty acids, which were separated and estimated by the usual methods, consisted solely of stearic acid (3·8 per cent.), palmitic acid (21·2 per cent.), and oleic acid (72·3 per cent.). The acid which Klimont and Meyer concluded to be margaric acid was found to be a eutectic mixture of stearic and palmitic acids (*cf.* ANALYST, 1921, **46**, 500.) The following glycerides were isolated by a method of fractional solution:—β-Palmitodistearin (m. pts.), 63·5°, (51·6°), 63·4° C.) present only in minute quantities; stearodipalmitin (m. pts., 57·6°, (47·0°), 57·6° C.), about 3 to 4 per cent.; dioleostearin, about 5 per cent.; dioleopalmitin, about 30 per cent.; and triolein, about 45 per cent. The fraction of fat melting at 27 to 32° C. probably contained further glycerides, with 1 molecule of oleic acid and 2 molecules of saturated fatty acids.

Solubility of Phenol in Liquid Paraffin. J. Cofman-Nicoresti. (*Pharm. J.*, 1922, **108**, 349.) Experiments described in detail have shown that the solubility of phenol (Acid Carbolic Cryst., B.P.) in commercial medicinal liquid paraffin does not exceed 1 per cent., and that any phenol in excess of that quantity, if dissolved in the hot oil, will separate as an oil when the solution cools. Reference is made to a case in which damages were obtained against a pharmacist who had dispensed a prescription for ear-drops, containing 6·2 per cent. of pure phenol, in liquid paraffin. After using half of the solution, the patient complained of pains in his ears, and sent the remainder of the preparation to an analyst, who found it to contain 10·3 per cent. of phenol.

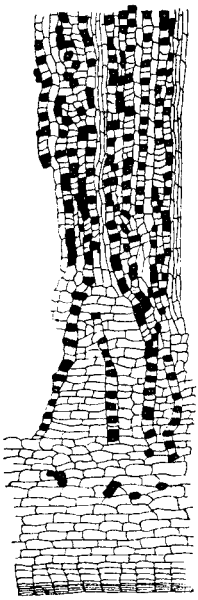
Pyrethrum Powder. D. Costa. (*Giorn. Chim. Ind. Appl.*, 1922, **4**, 91–93.)—The results of analyses of samples of Dalmatian insecticide, prepared from various species of *Chrysanthemum*, gave the following percentage results:—

	Moisture	Ether extract	Ash	Crude fibre
From the flowers alone	10·70	5·10	7·40	24·56
,, ,, ,, ,,	10·20	5·80	7·72	25·88
From flowers and stem	10·20	4·85	7·33	34·42
,, ,, ,, ,,	9·90	4·40	7·73	30·82
,, ,, ,, ,,	9·90	3·53	7·68	38·45
,, ,, ,, ,,	8·50	2·90	7·53	42·15

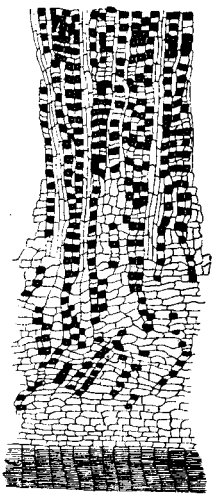
The last two samples had been prepared with a preponderance of stems. The percentages of water-soluble extract, calculated on the dry material, are for closed flowers, semi-closed flowers, open flowers and stems, 23·71, 17·85, 12·70 and 10·97 respectively. Estimation of this extract, together with microscopical examination, will indicate, with an accuracy of about 10 per cent., the proportion of stem in the powder, and also show if the latter consists of open, closed or mixed flowers.

T. H. P.

Yohimbine Bark. J. Small and F. M. J. Andrews. (*Pharm. J.*, 1922, **108**, 282–285, 311–314.) The difficulty of distinguishing true yohimbine bark from that of numerous similar and allied species which yield alkaloids closely resembling yohimbine, but have different physiological actions, has led to some contradictory accounts of its chemical and therapeutic properties. The history and botanical characters of different species of *Pausinystalia* and *Corynanthe* are described, and a review is given of the alkaloids prepared from them. Chemical tests of the bark have proved unsatisfactory, for, although the estimation of the total alkaloids is easy, no method for the quantitative separation of yohimbine and yohimbenine has been found. There is much evidence that yohimbine differs, both chemically and pharmacologically, from quebrachine. Genuine yohimbine bark is that of *P. yohimbe*, K. Sch.; this only differs microscopically from *P. macroceras* in the arrangement of the bast fibres and its characteristic punctiform lumen. The genuine bark occurs in channelled pieces, 4 to 10 mm. thick, having a tinge of red in the brown or grey-brown outer and inner surfaces; the outer surface is longitudinally furrowed, with the edges of the furrows not raised above the general level of the surface, there are narrow transverse cracks at intervals of 1 to 2 cm., and the cork adheres closely. Transverse sections under the microscope show characteristic beaded layers of bast fibres alternating with parenchymatous cells with little or no "twinning." Scrapings from the inner surface, when shaken with dilute sodium hydroxide (10 drops of 1·168 sp. gr. in 30 c.c. of water), give a red colour varying from wine red to reddish brown; dilute ammonia gives the same colour more distinctly, but slowly. The false bark from *P. macroceras* has little or no red tinge, and the edges of the longitudinal furrows are puckered, so that they stand up above the general level; the transverse cracks are very irregular, and the cork exfoliates easily. When the bark is treated with alkali, as above, a brown coloration with only a faint tinge of red results. Several other illustrations are given. H. E. C.



P. yohimbe.



P. macroceras.

Bacteriological, Physiological, etc.

Sweetening Value of Sweet Substances. T. Paul. (*Zeitsch. Untersuch. Nahr. Genussm.*, 1922, **43**, 137–150.)—The so-called "Constant" method, which has proved trustworthy in many branches of experimental psychology, has been adapted to the estimation of the sweetening power of sweet substances. Two

solutions of the particular substance are prepared, one of which tastes sweeter and the other not so sweet, as a standard (*e.g.* a 3 per cent.) solution of sucrose. Between these extremes further series of solutions, of definite concentration, are compared with the standard, and eventually the results in terms of "sweeter," "equivalent" and "not so sweet" are plotted in a system of curves; and the sweetening value calculated by the method of Spearman and Wirth. For each estimation the mean results, as found by 20 to 30 persons, should be taken. In this way it has been proved that the sweetening value of artificial sweetening agents, compared with sugar, is not, as hitherto generally assumed, of constant magnitude ("crystallose" saccharin = 450; dulcin = 250), but varies within wide limits with the concentration. Thus for ordinary concentrations (corresponding with 2 to 10 per cent. solutions of sugar) saccharin gives values between 200 and 700, and dulcin values between 70 and 350.

The following definitions have been adopted for this investigation: The *Sweetening Value* (*SG*) indicates the number of grms. of pure sucrose which must be dissolved in a definite volume of water to give a solution which tastes as sweet as a solution of 1 grm. of the substance in question, in the same volume of water. The sweetening value of the sugar = 1. By the *Molecular Sweetening Value* (*MSG*) is to be understood the number of moles (molecular weight expressed in grms) of sugar, which must be dissolved in a definite volume of water, to give a solution tasting as sweet as a solution of 1 mole of the substance in the same volume of water. The molecular sweetening value is calculated by multiplying the sweetening value by the molecular weight of the substance, and dividing the result by the molecular weight of sucrose (342·2). The *Sweetening Unit* (*SE*) is the value which indicates how many grms. of a sweet substance must be dissolved in a definite volume of water, to give a solution which tastes as sweet as a solution of 1 kilo. of sucrose in the same volume of water.

Unlike the artificial sweetening agents, sugars and other natural sweet substances have sweetening values which do not vary with the concentration of the solution. The following results have been obtained with natural products:— Dextrose, 0·53 (*SG*), 0·28 (*MSG*), lævulose, 1·05 (*SG*), 0·55 (*MSG*); sucrose 1·00 (*SG*), 1·00 (*MSG*); lactose, 0·27 (*SG*), 0·27 (*MSG*); glycol, 0·49 (*SG*); glycerol, 0·48 (*SG*); dulcitol, 0·41 (*SG*); mannitol, 0·45 (*SG*); sorbitol, 0·48 (*SG*); and glucose syrup (with about 78 per cent. of total solids), 0·26 (*SG*).

The sweetening and molecular sweetening values of saccharin (mol. weight 241·1) and dulcin (mol. weight 180·1), in comparison with sucrose as unity, are shown in the following table, in which the indices below the figures *SG* and *MSG*. represent the concentrations of the standard sugar solutions:—

Saccharin	667	545	400	333	316	250	216	200	187
Dulcin	364	250	138	104	90	82	76	72	70
Sucrose, grms. per litre	SG_{20}	SG_{30}	SG_{40}	SG_{50}	SG_{60}	SG_{70}	SG_{80}	SG_{90}	SG_{100}
Saccharin	470	384	282	235	223	176	152	141	132
Dulcin	192	132	73	55	47	43	40	38	37
Sucrose, grms. per litre	MSG_{20}	MSG_{30}	MSG_{40}	MSG_{50}	MSG_{60}	MSG_{70}	MSG_{80}	MSG_{90}	MSG_{100}

These results show that the sweetening value of saccharin and dulcin decreases with the rise in the concentration of the solution. In experiments with mixtures, it was found that, contrary to expectation, the sweetening value of an aqueous solution containing a mixture of saccharin and dulcin was approximately equal to the sum of the sweetening value of the individual constituents. Thus, for example, the sweetening value of a solution of 280 mgrms. of saccharin in 1 litre of water (equivalent to a 7 per cent. solution of sugar) was so intensified by the addition of only 120 mgrms. of dulcin (=a 3 per cent. solution of sugar), that it tasted as sweet as a solution containing 535 mgrms. of saccharin, or 1430 mgrms. of dulcin (=a 10 per cent. solution of sugar). This intensification of the sweetening value of saccharin by the addition of the less sweet dulcin reaches its maximum at a definite ratio between the proportions of the two substances. In the case of mixtures of saccharin and dulcin with sucrose, the sweet taste of the artificial sweetening agents has been proved by repeated experiments to be added to that of the sugar.

Gelatin as a Foodstuff. R. Robison. (*Biochem. J.*, 1922, **16**, 111–130.)—A description is given of experiments made by the author upon himself, in which different quantities of purified gelatin were added to a diet containing raw maize starch, lactose, sucrose, agar and a salt mixture. Small amounts of lemon juice and cod-liver oil were added to supply vitamins, whilst a little weak tea with lemon was also taken. Estimations were made of the nitrogen intake, the body weight, the weight and nitrogen content of urine and fæces, etc. The results obtained show that gelatin serves as a nitrogen sparer, in common with amino-acids, organic ammonium salts, etc., the maximum saving lying between the limits of 11·9 and 15·9 per cent. A fairly constant ratio exists between the creatinine nitrogen and the nitrogen balance (*N* intake − total *N* in urine) but the significance of this is unknown. T. J. W.

Estimation of Pectin as Calcium Pectate. M. H. Carré and D. Haynes. (*Biochem. J.*, 1922, **16**, 60–69.)—A volume of the solution which will yield from 0·02 to 0·03 grm. of calcium pectate is neutralised and diluted to about 300 c.c. One hundred c.c. of 0·1 *N* sodium hydroxide solution are added, and the mixture is left to stand overnight, after which 50 c.c. of *N* acetic acid, and, five minutes later, 50 c.c. of 2 *N* calcium chloride solution are added. After standing for one hour the liquid is boiled for a few minutes and filtered through paper. The residue is washed with boiling water until free from chloride, again boiled with water and filtered, this treatment being repeated until no further chloride is detected in the filtrate. The residue is finally collected in a weighed Gooch crucible and dried at 100° C. for 12 hours. The empirical formula of the precipitate obtained from apple juice corresponds closely to $C_{17}H_{22}O_{16}Ca$. Solutions containing very small amounts of pectin may be estimated by this method, whilst alcohol does not precipitate this substance in concentrations of less than 0·06 per cent. The extraction of pectin from apples for the above estimation is best effected by freezing thoroughly 50 grms. of finely minced material, allowing its

temperature to reach that of the room, and pressing the mass through cloth in a small hand press. The residue is ground with sand, extracted with cold water, and again pressed, the extraction and pressing being repeated from 60 to 80 times. The combined solutions are boiled, to destroy pectase, and then filtered through muslin and a pleated filter paper. Consistent results are obtained by the above method. T. J. W.

Occurrence of Amino-Acids in Cow's Milk. Y. Hijikata. (*J. Biol. Chem.*, 1922, **51**, 165–170.)—Two hundred litres of fresh milk were diluted with twice the volume of water, and the casein was precipitated by the addition of dilute acetic acid. Tannic acid was then added to precipitate the albumin, and the excess of tannic acid was removed by adding basic lead acetate, any lead then remaining in solution being precipitated as sulphide. The filtrate was evaporated to a small bulk, an equal volume of 60 per cent. alcohol was added, and the solution allowed to stand for a week, after which the precipitated lactose was filtered off. To the filtrate sufficient sulphuric acid to give a concentration of 5 per cent., and then phospho-tungstic acid were added, and the precipitate and solution analysed separately. Lysine, arginine and histidine were separated and identified, and it was concluded that monoaminoacids were also probably present. Guanine and adenine were found in the purine base fraction, and choline was separated from the lysine fraction. T. J. W.

Separation of Amino-Acids from the Products of Hydrolysis of Proteins, Etc. H. W. Buston and S. B. Schryver. (*Biochem. J.*, 1921, **15**, 636–642.)—After treatment of aqueous plant extracts with barium hydroxide (to remove sulphuric acid), alcohol, and phosphotungstic acid, the filtrate containing the amino-acids was concentrated *in vacuo*, diluted with an equal volume of 95 per cent. alcohol, and saturated with barium hydroxide, when a precipitate of barium dicarboxylates containing 13·9 per cent. of the nitrogen in the extract was obtained. After filtration, the filtrate and washings were saturated with barium hydroxide, and a current of carbon dioxide passed through the solution, when barium salts of amino-acid carboxylates were precipitated. This treatment was repeated seven times, and diminishing amounts of nitrogen in the precipitates were obtained, 2·6 per cent. of the total amino-nitrogen present before precipitation with carbon dioxide remaining. Attempts were made to overcome the necessity for the numerous precipitations, but were unsatisfactory. The precipitated carboxylates were decomposed by boiling them with water for a few minutes, and the solution filtered, the barium in solution separated as barium sulphate and filtered off, and the filtrate decolorised with animal charcoal and evaporated *in vacuo* to a syrup. On shaking this with absolute alcohol, a granular solid was obtained, which was washed with alcohol and ether and dried in a vacuum desiccator. The substances thus obtained contained a large proportion of amino acids, the whole of the nitrogen present being in the amino form. Promising results are indicated by the application of this method to the hydrolytic products of caseinogen and gelatin. T. J. W.

Amino-Acids of Flesh. J. L. Rosedale. (*Biochem. J.*, 1922, **16**, 27–30.)—Analyses were made of the flesh of rabbits, chickens, oxen, horses, sheep and pigs, and samples were taken from different parts of the bodies of the smaller animals. The method consisted in removing all fat from the tissue, mincing about 350 grms., and immersing it in boiling water containing 0·1 per cent. of acetic acid for ten minutes. The tissue was squeezed dry in a cloth, and the treatment in water repeated twice. The residue was then digested with 1 grm. of pepsin in 2 litres of 0·1 *N* hydrochloric acid for ten days at 37° C., after which the liquid was filtered, and the nitrogen estimated in the filtrate. Portions of the filtrate containing about 6 grms. of protein were hydrolysed by boiling with 20 per cent. hydrochloric acid for thirty-six hours, and the liquid was then evaporated to dryness *in vacuo*, the residue diluted to 250 c.c., and two samples of 100 c.c. each were analysed by the van Slyke method (*J. Biol. Chem.*, 1911, **10**, 15.) The arginine estimation was made by Plimmer's modified method (ANALYST, 1916, **41**, 285). The amounts of total di-amino nitrogen found were as follows: Rabbit, 44·1 to 45·7; chicken, 25·5 to 27·0; ox, 28·5; horse, 37·1; sheep, 38·3; and pig, 28·2 per cent. The proportion of humin nitrogen is somewhat higher in white meat, ranging from 1·2 to 3·0 per cent., whilst the average for the red meats is 0·5 per cent. Red meats contain an average of 11 per cent. of lysine, but this constituent varies between 2 and 7 per cent. for white meat. The arginine present is constant in amount at 14 to 15 per cent. in both white and red meats, with the exception of the fore legs of rabbits and chickens' legs, in which 8 per cent. is present. The figures obtained for histidine are somewhat unsatisfactory, as the higher ones correspond with low non-amino nitrogen, and *vice versa*. T. J. W.

New Colorimetric Method for the Estimation of Plasma Proteins. H. Wu. (*J. Biol. Chem.*, 1922, **51**, 33–39.)—The proteins are separated by a slight modification of the Cullen and van Slyke method (ANALYST, 1920, **45**, 226–227), fibrin being precipitated by the addition of calcium chloride solution to the "oxalated" plasma, globulin by half-saturation of the solution with ammonium sulphate, and albumin by precipitation with sodium tungstate. The amounts of the proteins present after separation are estimated by comparison of the colours produced on the addition of the phospho-molybdic-tungstic acid phenol reagent, previously described by the author (*J. Biol. Chem.*, 1920, **43**, 208), with those obtained by the use of a standard solution of tyrosin. This standard is prepared by dissolving 50 mgrms. of tyrosin in 250 c.c. of 0·1 *N* hydrochloric acid, and will keep in good condition for at least six months. Under the conditions described, it has been found experimentally that 1 mgrm. of tyrosin is equal in colorimetric value to 16·4 mgrms. of fibrin, 25·2 mgrms. of globulin, or 27·5 mgrms. of albumin. The above figures apparently indicate that fibrin has a higher tyrosin content than the other proteins, but the greater intensity of colour is probably due to an increase of the chromogenic value of the fibrin by the action of the sodium hydroxide solution in which it is dissolved. Results given in tabular form indicate that such estimations may be of value in clinical work. T. J. W.

Estimation of Carnosine in Muscle Extract. G. Hunter. (*Biochem. J.*, 1921, **15**, 689–694.)—The following is an application of the Koessler and Hanke method (*J. Biol. Chem.*, 1919, **39**, 497) to the estimation of carnosine:—About 1·5 grm. of muscle is extracted with 20 c.c. of water at 70° C. for thirty minutes, and the mixture is filtered. The residue is ground to a pulp and extracted twice with 20 c.c. portions of water. The filtrates are mixed, slightly acidified with acetic acid, and heated to 70° C. for a few minutes, when the proteins are completely precipitated. The precipitate is filtered off through glass wool, and the solution used for the colour reaction, as in the Koessler-Hanke method. Suitable colour standards are prepared by mixing 0·1 c.c. of 0·1 per cent. methyl orange and 0·25 c.c. of 0·5 per cent. Congo red solution, and diluting the mixture to 100 c.c. The best results were obtained when the test cylinder contained 0·02—0·04 mgrm. of carnosine, the maximum coloration being attained in eight to twelve minutes, and remaining stable for a further eight minutes. Solutions containing carnosine, after heating to 100° C. for one hour, yielded less colour than the original solution, and filtration through three filter papers in succession caused a loss of 44 per cent. of the carnosine present. There is reason to believe that part of the colour obtained is due to substances other than carnosine present in the muscle extract.

T. J. W.

Distribution of Carnosine in the Animal Kingdom. W. M. Clifford. (*Biochem. J.*, 1921, **15**, 725–735.)—The quantitative method used in this research consisted in the preparation of an aqueous muscle extract, from which the proteins were removed by metaphosphoric acid, and in the production of colour by diazotisation and comparison of the coloration with those of standard solutions in a colorimeter (*cf.* ANALYST, 1921, **46**, 507). An extensive series of estimations with muscle has led to the following conclusions: Carnosine is absent from the flesh of all invertebrates, white and flat fish, chelonians, and birds belonging to the finch and owl tribes, but is found in fishes rich in fat, most reptiles and amphibians, in birds, and in all mammals. The amount present is practically constant in individuals of any one species, as is indicated by the following figures: Rabbits, 0·13—0·16; beef, 0·98—1·12; and mutton and lamb, 0·37—0·42 per cent. Animals and fish kept under ordinary conditions for four days after death showed no decrease in the amount of carnosine originally present, but putrid meat yielded a smaller amount. Commercial fish and meat pastes were tested for carnosine, but only in the case of two products were bases found. Carnosine is not an absolute necessity to animal life, since many species exist without it, but the large amounts present in some cases, *e.g.* beef 3 per cent. and pheasant 0·17 per cent. of the solids respectively, indicate that it is probably of some use. Since this substance is not excreted in the urine, it must be broken down, probably by erepsin, since it is stable to pepsin and trypsin, and must thus supply energy, so that meat extracts containing from 7 to 11 per cent. of carnosine are not without food value. Carnosine is the only known substance containing a β-amino-acid occurring in the animal body, but the significance of this is unknown.

T. J. W.

Vitamin Content of Some Indian Foodstuffs. S. N. Ghose. (*Biochem. J.*, 1922, **16**, 35–41.)—Experiments were made upon rats supplied with a basal diet to which were added the substances under examination in the usual manner. Pure "ghee," whether derived from cow's or buffalo's milk, was equal to pure butter in its content of vitamin *A*, but re-melted, or adulterated samples, failed to promote growth, or required the administration of large quantities. Coconut oil and pure mustard seed oil induced growth when supplied in quantities of 10 to 20 per cent. of the basal diet. Several varieties of lentils showed a high vitamin *B* content. Considerable amounts of vitamin *B* were found in crude "attah," and in unbleached Indian flour, but bleached (pure white) flour was deficient in this constituent. T. J. W.

Quantitative Estimation of the Fat-Soluble Factor (Vitamin *A*). S. S. Zilva and M. Miura. (*Biochem. J.*, 1921, **15**, 654–659.)—Rats weighing from 50–60 grms. were fed upon the usual basal diet, with the result that growth declined in ten to fifteen days and afterwards ceased. A small percentage of vigorous animals, however, continued to grow during the first few weeks, and these were omitted from the experiments. Any animal reaching a weight exceeding 70 grms. in three or four weeks was considered unsuitable for testing purposes. Liquid oils, diluted if necessary with an inactive oil such as oxidised olive oil, were delivered in drops of known weight into a depression in a small pellet of basal diet, and covered with the powdered diet and given to the rats, after which the daily ration of basal diet was supplied. Solid fats were melted at a low temperature, and drops of known weight were allowed to solidify and supplied to the rats before the basal diet was given. The standard for comparison adopted was the least dose which induced definite growth for four weeks after the animals had ceased to grow, the line of demarcation at this point being readily observed and consistent results obtained. Various cod-liver oils examined showed a minimum dose varying from 1·7 to 5 mgrms., and butters, which were much less potent, required the administration of 200 to over 400 mgrms. to obtain similar results. T. J. W.

Occurrence of Fat-Soluble Vitamin *A* in Relation to Plant Pigments. H. Steenbock and M. T. Sell. (*J. Biol. Chem.*, 1922, **51**, 63–76.)—By feeding rats upon a basal diet containing adequate amounts of vitamins *B* and *C* the relative amount of vitamin *A* contained in plants of varying pigment content has been determined. Experiments were made with three varieties of sweet potato, ranging in colour from creamy white to an intense yellow, two samples of white carrots, and one each of yellow and reddish yellow colours, and white and green cabbage leaves. In all cases the higher content of vitamin *A* was associated with the greater content of pigment. The tops of white carrot roots, which had developed pigment by exposure to light during growth, were found to be richer in vitamin than the lower portions of the same roots containing only half as much pigment. T. J. W.

Colorimetric Method for the Estimation of Sugar in Normal Human Urine. O. Folin and H. Berglund. (*J. Biol. Chem.*, 1922, **51**, 209–211.)—To 5 c.c. of strong urine, or 10 to 15 c.c. of more dilute specimens, 5 c.c. of 0·1 *N* sulphuric acid are added, and the final volume is made up to 20 c.c. by the addition of water, if necessary. One and a half grms. of Lloyd's alkaloidal reagent (a concentrated fuller's earth) are added, and the mixture shaken gently for two minutes and filtered. This treatment removes most of the colouring matter, together with uric acid, creatine and creatinine, but the sugar present is unaffected. Ten c.c. of the filtrate are heated with 1 c.c. of 10 per cent. hydrochloric acid in a boiling water-bath for 75 minutes, cooled, neutralised to phenolphthalein by the addition of sodium hydroxide solution, and diluted to 20 c.c. To remove the colouring matters formed during hydrolysis, a pinch of the alkaloidal reagent is added, the tube is inverted six times, and the solution then filtered. The sugar is estimated by the Folin and Wu method as applied to blood (ANALYST, 1920, **45**, 227) standards for comparison containing 1 or 2 mgrms. of dextrose per 10 c.c. being used. In order to prevent deterioration, the standards are made up with 0·3 per cent. aqueous benzoic acid solution, and the same solution is used for dilution when required. T. J. W.

Gasometric Estimation of Urea. R. L. Stehle. (*J. Biol. Chem.*, 1922, **51**, 89–92.)—In a reply to criticism by Menaul of the author's method (ANALYST, 1921, **46**, 412), it is pointed out that the discrepancies were due to the assumption that the solution remaining after the reaction between sodium hypobromite solution and urea possessed the same vapour tension as water. By adopting Dehn's hypobromite solution (*J. Amer. Chem. Soc.*, 1907, **29**, 1317) (prepared by dissolving 100 grms. of sodium hydroxide in 250 c.c. of water, and adding 10 c.c. of bromine to each 100 c.c., but omitting the addition of an equal volume of water), and correcting the volume of gas in accordance with the following figures, results may be obtained with an error not exceeding 1·5 per cent.

	Vapour tension		
Temperature	Sodium hypobromite	Water	Difference
12° C.	3·3 mm.	10·5 mm.	7·2 mm.
16° ,,	5·3 ,,	13·6 ,,	8·3 ,,
20° ,,	8·6 ,,	17·4 ,,	8·8 ,,

The suggestions of Chattaway, Dowell and Krogh, that the discrepancies in the estimation are due to the formation of dibrom-urea or nitrogen tribromide, or to the formation of carbon monoxide and incomplete liberation of nitrogen, are shown to be untenable. T. J. W.

Inorganic Analysis

Xylenol Blue as an Indicator in Chemical and Biochemical Work. A. Cohen. (*Biochem. J.*, 1922, **16**, 31–34.)—Xylenol blue may be prepared by heating in a brine bath for six hours a mixture of 2 parts of *o*-sulphobenzoic dichloride, 2 parts of fused zinc chloride, and 3 parts of *p*-xylenol (m.pt. 74·5° C. and b.pt. 211·5° C.). The fused mass is disintegrated in 8 parts of hot water, the liquid filtered, and the residue washed with hot water and a little alcohol, and dissolved in sodium hydroxide solution. Hydrochloric acid is then added, with stirring, and the precipitated indicator separated by filtration and crystallised from alcohol, as a brown solid. The indicator solution is prepared by dissolving 0·2 grm. of the solid in 100 c.c. of absolute alcohol, or by boiling 0·6 grm. in about 80 c.c. of water containing 1·47 c.c. of *N* alkali, and diluting the solution, when cold, to 100 c.c. The P_H indications given by this substance range from 1·2 (red) to 2·8 (yellow), and from 8·0 (yellow) to 9·6 (blue). In comparison with thymol blue, the new indicator yields similar results with half the concentration, and the blue colour in the alkaline range is purer. Xylenol blue does not precipitate from buffer solutions on standing for three months. A titration flask is described to which a cordite (test) tube is fused horizontally, thus facilitating colour comparison, and also serving to agitate the liquid when the flask is tilted.

T. J. W.

Hydrated Oxalic Acid as an Oxidimetric Standard. A. E. Hill and T. M. Smith. (*J. Amer. Chem. Soc.*, 1922, **44**, 546–557.)—Pure oxalic acid which has been recrystallised twice is sufficiently free from all impurities, other than water, for use as a standard for alkalimetry or oxidimetry; the only source of error is in respect of its water content, as crystals always include some of their mother-liquor, usually to the extent of 0·2 to 0·5 per cent. On account of variations in vapour tension due to temperature, drying over dilute sulphuric acid having the calculated vapour tension is unsatisfactory; but a mixture of hydrated and anhydrous oxalic acid (prepared by heating the acid in a large dish in the water bath) has the correct vapour tension in equilibrium with the hydrate at all temperatures. The pure dry hydrated acid is therefore prepared by powdering the recrystallised acid to pass a No. 100 sieve and placing it in a porcelain boat in a length of wide combustion tube; air is drawn over it which has passed through a saturated solution of oxalic acid, and then over a mixture of the hydrate and anhydrous acid. One hour's drying in this manner is sufficient, and the results obtained with the acid so prepared as an oxidimetric standard are accurate to 0·02 per cent.

H. E. C.

Nature of Acid Water from Coal Mines and the Estimation of Acidity. W. A. Selvig and W. C. Ratliff. (*J. Ind. Eng. Chem.*, 1922, **14**, 125–127.)—Water from coal mines is usually decidedly acid in reaction, owing to the presence of free sulphuric acid and iron and aluminium sulphates, these being formed by

the action of air and water on the pyrites associated with the coal. Direct titration of the acidity with sodium hydroxide solution, with methyl-orange as indicator, yields too high results on account of hydrolysis of ferric and aluminium sulphates; if the ferric sulphate is reduced previously by treatment with potassium iodide solution, and the liberated iodine destroyed by the addition of thiosulphate solution, the results obtained are more nearly correct. For instance, a water containing 299 parts per million of actual free sulphuric acid (as found after allowing for the acidity of the iron and aluminium sulphates estimated gravimetrically), gave results only 73 parts per million too high after reduction of the ferric sulphate, whilst titration without previous reduction gave results 416 parts per million too high. Correction for the aluminium sulphate can be made only by estimating the amount of this salt present. The total acidity of the water, as estimated by titration at the boiling temperature (with phenolphthalein as indicator), probably gives the best results for practical purposes, since the iron and aluminium sulphates are latent sources of free acid, and play an important part in the corrosive action of mine water. W. P. S.

Estimation of Free Acid in Aluminium Sulphate Solutions. H. Zschokke and L. Häuselmann. (*Chem. Zeit.*, 1922, **46**, 302.)—Ten c.c. of the solution are treated in a graduated 100 c.c. flask with 10 c.c. of 10 per cent. barium chloride and 5 c.c. of 10 per cent. potassium ferrocyanide solution (not older than 6 days), followed by 60 c.c. of boiling water; the temperature of the solution should not be higher than 85° C. Gelatin solution (2 per cent.) is then added, drop by drop, while stirring, until the precipitate flocculates and settles well (1–1·5 c.c.). After cooling, the volume is made up, and the liquid filtered. Fifty c.c. are diluted with the same volume of water and titrated with 0·1 *N* sodium hydroxide solution in presence of methyl-orange. If the liquid is neutral to the indicator before titration, a fresh trial is made, with the addition of a few c.c. of 0·1 *N* sulphuric acid at the start. In this manner any deficiency of acid may be estimated. If the acidity is high (more than 6 grms. per litre), a few c.c. of 0·1 *N* alkali must be added before precipitation. The excess of ferrocyanide must not be too great; otherwise the results will be low; the above proportion is suitable for liquors containing 7 to 9 grms. of Al_2O_3 per litre. W. R. S.

Method for Titrating Copper. S. Minovici and A. Jonescu. (*Ann. Chim. anal.*, 1922, **4**, 99–102.)—Ammonia is added drop by drop to a copper sulphate solution until the precipitate re-dissolves; the deep-blue solution is treated with eight times its bulk of alcohol while stirring. The violet crystalline precipitate of tetramminecupric sulphate, $CuSO_4.4NH_3$, is filtered off, washed with 98 per cent. alcohol until the washings are neutral to litmus paper, and rinsed back with 100 c.c. of water; the solution is titrated with 0·1 *N* acid, in presence of methyl red, until the solution clears and the colour changes from greenish to reddish-violet. One c.c. of 0·1 *N* acid = 0·006225 grm. $CuSO_4.5H_2O$. The method is stated to be accurate and applicable in presence of other metallic salts which are neutral and do not combine with ammonia. W. R. S.

Estimation of Carbon in Cast Iron and Steel by Corleis' Method. G. Batta and H. Thyssen. (*Bull. Soc. Chim. Belge*, 1922, **31**, 112–117.)—The estimation of carbon by the sulphuric-chromic acid method was found always to give slightly high results, due to incomplete absorption of moisture. It is indispensable to pass the gases through 2 to 3 absorbers containing sulphuric acid, and to regulate the suction so that the speed of the gases did not exceed one bubble per second. Another drawback of the method is that it cannot be applied to certain steels, especially those high in chromium. Combustion of the metal in oxygen at 1100° C. is the best method, being quicker, more economical, more easily carried out, and of general applicability (*cf.* ANALYST, 1921, **46**, 343).

W. R. S.

Separation of Ferric Oxide and Alumina from Lime by the Nitrate Method. Charriou. (*Comptes rend.*, 1922, **174**, 751–754.)—The following procedure prevents the co-precipitation of lime with ferric oxide and alumina:—A solution containing 0·56 grm. of calcium oxide, 2 grms. of ammonium nitrate and either 0·141 grm. of ferric oxide or 0·166 grm. of alumina is treated with 2 c.c. of a solution containing 11 mols. of ammonia per litre, the whole dried at a temperature not exceeding 150° C., so that all the ammonium nitrate may not be decomposed, and the resulting mass taken up and washed by decantation, with boiling water. The process may be accelerated by dissolving the residue insoluble after two decantations in boiling nitric acid, decomposing it at about 250° C., and taking the residue up in 50 c.c. of boiling 5 per cent. ammonium nitrate solution, the ferric oxide and alumina then remaining in a dense, granular form capable of rapid washing by decantation. The difficulty of removing the adherent oxide completely from the dish during the washing may be overcome either by weighing the dish beforehand, and then calcining and weighing the oxides in it, or by dissolving the remaining particles of the oxides in nitric acid, reprecipitating with ammonia and filtering. In all the experiments the total volume of the washings, in which the lime was subsequently estimated, was 500 c.c.; the amounts of ammonium nitrate introduced were found to be without influence on the estimation of the calcium as oxalate.

T. H. P.

Rapid Analysis of Potassium Perchlorate. V. Lenher and M. Tosterud. (*J. Amer. Chem. Soc.*, 1922, **44**, 611–612.)—The following method is rapid and satisfactory for most purposes, giving results which are generally 0·2 to 0·3 per cent. low on account of volatilisation of potassium chloride. The sample (0·5 grm.) is intimately mixed in an agate mortar with 1 grm. of manganese dioxide, transferred to a porcelain crucible, heated for 15 minutes at 600°–700° C., cooled, and extracted with hot water, and the chlorine estimated by Mohr's or Volhard's method. A blank experiment must be made with the manganese dioxide. If greater accuracy is required, Lamb and Marden's method (*cf.* ANALYST, 1912, **37**, 374) is recommended.

H. E. C.

Physical Methods, Apparatus, etc.

Estimation of Krypton and Xenon by Spectrophotometry. C. Moureu and A. Lepape. (*Comptes rend.*, 1922, **174**, 908–913.)—The spectrophotometric method of estimating krypton and xenon is simplified and rendered absolute by preparing artificial standard solutions of pure krypton and xenon in pure argon. The gaseous krypton or xenon mixture to be tested is, if necessary, either diluted with pure argon, or concentrated by fractionation with the help of coconut charcoal cooled to –80° C., and then subjected to spectrophotometric examination in a Plücker tube. Comparison of the intensity of the principal ray of the krypton or xenon thus obtained with the values obtained with the standard solutions gives the proportion of the gas present, with errors of less than 10 and 20 per cent. in the case of krypton and xenon respectively. T. H. P.

The Sugar Tube Method of Estimating Rock Dust in Air. A. C. Fieldner, S. H. Katz and E. S. Longfellow. (*U.S. Bureau of Mines Tech. Paper*, **278**, 1–40.)—The method consists in filtering a measured volume of the air through a layer of finely ground sugar in a glass tube; the sugar is afterwards dissolved, filtered through paper of close texture and the residue ignited and weighed. The number of dust particles may also be estimated microscopically by counting the number in a small volume. The efficiency has been determined by means of silica dust clouds and by means of tobacco smoke, the incoming and outgoing dust being examined in a beam of light in a Tyndall box. It is found that the efficiency of the tubes increases with increase of diameter and decreased rate of flow. Wetting the sugar with water or 35 per cent. alcohol only increases the efficiency by about 5 per cent. In making the tests it is important to obtain the figures before clogging takes place, as the apparent efficiency rapidly increases when the dust cloud is dense. Increase of fineness of the sugar also increases the efficiency, especially against the finer particles, such as those of tobacco smoke; when a tube of $2\frac{1}{8}$ in. diameter is used, efficiency is 27 per cent. for 20 to 35 mesh sugar, 60 per cent. for 48 to 65 mesh, and over 90 per cent. for 48 to 150 mesh; but with finely ground sugar, pressures up to 4 in. of mercury are necessary to force the air through the filter. As the effect of the depth of the sugar layer grows less as the depth increases, there is no advantage in making a layer more than 3 ins. deep. It is necessary to make a blank test on each batch of sugar, and to allow for the incombustible dust particles contained in it. H. E. C.

Improvised Electric Thermostat constant to 0·02° C. S. C. Bradford. (*Biochem. J.*, 1922, **16**, 49–52.)—The efficiency of this apparatus depends chiefly upon the stirrer, which consists of a vertical glass tube bearing, at its lower end, a cork bung immersed in the thermostat liquid, and near the upper end two rubber corks, a short distance apart. An iron plunger is mounted concentrically about the middle of the tube, and is surrounded by a solenoid. When in its lowest position the upper rubber cork strikes a lever, thus closing an electric

circuit and magnetising the solenoid, which then raises the plunger and stirrer, until the lower rubber cork strikes the lever and breaks the circuit, when the stirrer descends under the influence of gravity and the cycle is repeated. The regulator is similar to the ordinary toluene form for gas, and is provided with a column of mercury and two platinum wire contacts, one of which is adjustable. The electric current controlled by the regulator is derived from two accumulator cells, and also serves to operate a magnetic high-resistance relay, which controls the supply of current to the heating lamp immersed in the thermostat. In order to avoid corrosion by sparking, the contacts are made of plumbago cylinders 8 mm. in diameter; they work efficiently if rubbed with sandpaper every 48 hours. The thermostat has a capacity of about 5 litres, and is connected with a Marriott's bottle, in order to maintain a constant level. During a run of 24 hours the temperature ranged between 23·50° and 23·52° C., with two intervals, each of less than a minute in duration, at 23·53° and 23·525° C. The whole apparatus is easily constructed and may be fitted up from material readily obtained.

T. J. W.

Reviews.

A Concise History of Chemistry. By T. P. Hilditch, D.Sc., F.I.C. Second Edition. Pp. xi+276. London: Methuen & Co. 1922. Price 6s.

The writer who craved the indulgence of his readers because he had no time to make his book shorter might well urge this plea if he attempted to put together a concise history of chemistry. In such a work the amount of material to be handled is vast. If the space in which to pack it is strictly limited much of the author's time and thought is necessarily spent in the business of compression. If done well, the work will be as full as the proverbial egg, but, unlike the curate's egg, to be good it must not be merely good in places. How to deal adequately with the varied subject-matter, how to arrange it systematically, and to present it consecutively and logically, in sufficient detail to be accurate and yet concise, to be sparing of words and yet clear and intelligible, and to make of the whole a well-balanced story, of which every section shall be duly proportioned, is a problem of no small difficulty. On the whole, Dr. Hilditch has solved the problem satisfactorily. It is no mean achievement to have succeeded in giving a fairly complete account of the rise and development of chemistry within the space of some 250 small 8vo pages. That the value of his work is recognised is evident from the fact that a second edition has been called for. Presumably it is intended mainly for students or for those who have at least a fair general knowledge of the science. A person practically ignorant of chemistry would not get very far into the book without coming to an absolute standstill. He is not likely to be greatly edified, for example, by the statement (p. 44) that the "application of Planck's quantum theory" has afforded evidence of the structure of atoms when he is nowhere informed in the book what Planck's quantum theory is.

If the book has a serious fault, it is that it attempts too much. It seeks to get more into the pint pot than the pint pot will hold. The "tyranny of space" has, at times, compelled the author to curtail unduly, when to be instructive and illuminating he ought to expand. He occasionally strives to pursue a subject to its logical finish, and then suddenly breaks off with a somewhat halting conclusion, to resume the matter in a subsequent part of the work. Such disconnected treatment is not calculated to afford the reader clear and definite impressions.

But it must be freely acknowledged that the book has many commendable features that the student will appreciate, and these far outweigh such slight demerits as it possesses. Its synoptical tables, for example, contain a mass of information in a very little space. Some idea of the range the work covers may be gleaned from a glance at the index of names and of subjects. The information is generally accurate, but, as might be anticipated, when the amount of material to be dealt with is considered, there are a few slips which, in view of future editions, it may be desirable to indicate. Thus "Sir W. Lockyer" (p. 48) should be "Sir N. Lockyer"; "Bergmann" (p. 48 *et seq.*) should be "Bergman"; "Graebe" is occasionally so printed, but more frequently appears as "Gräbe"; "Pettersen" (p. 190), "Petersen" (p. 194) should be "Pettersson"; "Hofmann" (p. 212) should be "Hoffmann" (the contemporary of Stahl); "Michael" (p. 135) should be "Michaelis"; "Humphrey Davy" (p. 227) should be "Humphry Davy".

Boisbaudran (p. 229) was a brandy-merchant, not a Professor at Paris; Kekulé (p. 232) was Professor at Ghent, not at Geneva; the baptismal name of Cahours (p. 230) was Auguste.

"Reflex" (p. 209) should be "reflux"; "berryllium" (p. 190) should be "beryllium". In this connection it may be noted there is apparently a growing tendency to revert to this name, which originated with Klaproth, in preference to glucinum, from glucine, so termed by Vauquelin, the discoverer of the element. The International Committee on atomic weights ruled by a majority that in their Reports the names of the elements should be those given by their discoverers. The Germans have consequently, no warrant to designate glucinum as beryllium, or columbium as niobium. Strontium was not discovered by Klaproth (p. 225), but by Hope. Its existence in strontianite was surmised by Crawford. Cavendish did not discover hydrogen (p. 224, compare p. 23) or invent eudiometry (p. 224), or study the volumetric composition of nitric acid. He ascertained the qualitative composition of nitric acid, but cannot be said to have determined its "constitution" (p. 67)—using that term in its accepted sense. He certainly never exploded hydrogen and chlorine (p. 216), nor used hydrogen in determining the composition of air (p. 24).

Dulong's name is not specially associated with the oxides of nitrogen (p. 226). A more interesting reference would be to nitrogen chloride, which he discovered in 1812, and by which he was maimed.

It is not strictly accurate to imply that Dalton was the first to enunciate the doctrine of atoms. In connection with his assumption of atoms to explain the phenomena of chemical combination, it may be pointed out that Cavendish in his

Phil. Trans. papers on the Freezing Points of Acids had tacitly assumed the laws of constant and reciprocal proportions in his quantitative determinations of their strengths. Nor is the statement (p. 72) that Berzelius and his co-workers discovered many ores containing chromium, molybdenum, vanadium, and allied metals, justified by the facts. The first notice of a compound of columbium was made by Hatchett and not by Rose (p. 74). Tantalum was discovered by Ekeberg and not by Hatchett (p. 74). There are typographical errors in the formulæ of the cobaltammine chlorides on p. 58, as well as in that of PCl_5 on p. 118.

Contrary to the implication on p. 42, Marignac, as pointed out by Mallet, was never wholly convinced of the invalidity of Prout's "Law." He was of opinion that anyone who would look impartially at the facts could hardly escape the feeling that there must be some reason for the frequent recurrence of whole numbers among the atomic weights.

Boyle is not generally regarded as a brilliant writer. His style is prolix and tedious in the last degree. One calls to mind Swift's merciless "Pious Meditation on a Broomstick in the Style of the Honourable Mr. Boyle." Priestley, too, is not usually considered to have been a wealthy chemist (p. 208). His riches, like Brotherton's, consisted not in the abundance of his possessions, but in the fewness of his wants. Had it not been for the generosity of his friends—Wedgwood, Watt, Boulton, and others—much of his scientific work would never have been attempted.

T. E. THORPE.

THE EMISSION OF ELECTRICITY FROM HOT BODIES. By O. W. RICHARDSON, F.R.S. Second Edition. Pp. viii+320. London: Longmans, Green & Co. 1921. Price 16s net.

This volume is one of a well-known series of monographs on physics, and deals with the thermionic properties of heated bodies.

It has been known since the early part of the 18th century that all bodies acquire the power of conducting electricity at high temperature and confer this property on the surrounding space. Little systematic work was done on the subject, until Becquerel showed, in 1853, that air at a white heat was unable to insulate under a potential difference of a few volts. Elster and Geitel, Brown, and others continued the work, but, in the absence of a satisfactory hypothesis to link up the facts and indicate further lines of research, the experimentation was of a tentative and exploratory character. At the close of the 19th century, however, the Theory of Ions came to supply the need, and, under the stimulus of the discoveries of Roentgen and Becquerel, was rapidly developed, chiefly by Sir J. J. Thomson, into a coherent theory, which gave a rational connection between the known facts, and indicated new lines of research. Within the last few years the importance of the subject in its technical applications has led to extraordinarily rapid developments, both in the theory and its applications. So much so, indeed, that it has not been possible to deal with the technical developments in this volume, but, as an exposition of recent experimental and theoretical developments, the book is very full and complete.

The subjects treated of include Theory of Emission of Electrons from Hot Bodies—Temperature variation of Electron Emission—The Effects of Gases on the Emission of Electrons—Energetics of Electron Emission—The Emission of Positive Ions by Hot Metals—The Effects of Gases on the Liberation of Positive Ions by Hot Metals—The Emission of Ions by Heated Salts—Ionization and Chemical Actions.

The last chapter, which is of particular interest to chemists, deals, among other things, with the pressure of ions in the gases liberated by the electrolysis of liquid, the ionisation of air which has been drawn over phosphorus, the ionisation accompanying the hydration and dehydration of crystals, the emission of electrons in the presence of an alloy of sodium and potassium in the various gases, and the ionisation of gases by heat.

Copious references to original papers are given throughout. For a full understanding of the book some familiarity with the language of differential equations is necessary. A. RITCHIE SCOTT.

LABORATORY EXERCISES IN APPLIED CHEMISTRY FOR STUDENTS IN TECHNICAL SCHOOLS AND UNIVERSITIES. By WILHELM MOLDENHAUER. Authorized Translation by LAWRENCE BRADSHAW, D.Sc., Ph.D. Pp. xii+236. London: Constable & Co. Ltd., 1921. Price 12s. 6d.

The author of this book is Privatdozent at Darmstadt Technical School. He mentions, in his Preface, that " a student usually begins technical analysis at a comparatively early stage in his course." Though what would be called an early stage in a Continental course would mean a different period in this country, the fact remains that special branches have sometimes to be taught before an adequate knowledge of general chemistry gives the student fuller powers of utilisation.

The book is, in the first place, concerned with giving directions for the analysis of the following industrial substances: Coal, water, coal-gas, balloon-gas, spent oxide, pyrites, nitroso-sulphuric acid, "oleum," Chile saltpetre, black ash, products of the ammonia-soda process, Weldon mud, Stassfurt potash salts, superphosphate, basic slag, organic manures, iron ores, iron, zinc blende, zinc dust, galena, oils, fats, waxes, soap, glycerin, and lubricants. Following each analytical scheme is some description and explanation of the principles thereof, affording the student some idea of the utility and significance of his laboratory work. Further stimulation of the student's interest is attempted by outlining the manufactures and industries concerned.

The analysis of drinking-water is carried out by methods, some of which are not likely to meet with favour in this country, and the results are inadequately explained. There is the extraordinary statement that nitrous acid is a metabolic product of pathogenic bacteria, and that water containing it may be very dangerous to health. It seems probable that the power of the cholera vibrio to reduce nitrates to nitrites and to produce the latter from the products of proteolysis has made too strong an impression on the mind of the author. However, the book bears every

evidence of sincere attempts on the parts of both author and translator to do their very best to teach a none-too-easy subject. But it may be protested that Hungary does not enjoy a monopoly of water containing sodium bicarbonate. This country also contains such. WILLIAM PARTRIDGE.

CHEMICAL DISINFECTION AND STERILISATION. By S. RIDEAL, D.Sc., and ERIC K. RIDEAL, D.Sc., M.A. Pp. vii+313. London: Edwin Arnold & Co., 1921. Price 21s. net.

With the recognition of the all-pervading part played by micro-organisms in nature and industry, the necessity for controlling or preventing their action and growth has given rise to a highly specialised department of science, and Drs. S. and E. K. Rideal have done a valuable service in producing a compact, comprehensive and up-to-date résumé of our present knowledge of the subject, in connection with which one of the authors is already well known.

The volume is divided into 14 chapters, and there are author and subject indexes, references, at the foot of almost every page, to current literature, and an excellent bibliography at the end of each section. So thoroughly does this part of the work appear to have been carried out, that it is somewhat surprising to find no mention of the well-known book by Dr. S. Rideal, entitled "Disinfection and the Preservation of Food," in which some of the headings and many whole paragraphs are identical with those in the present volume.

The first chapter is introductory, the next five deal with the specific methods of disinfection applied to air, food, water, etc., and what the authors term "Public Disinfection," *i.e.* the disinfection of rooms, clothes, public buildings and vehicles. Then follow a section on personal disinfection, as employed in medicine and surgery, and another on the destruction of some non-bacterial parasites of plants and animals. After this, about 100 pages are devoted to a consideration of the individual chemicals employed, prefaced by an extremely interesting chapter on the relation between chemical constitution and bactericidal action.

Under the heading "Methods of Analysis and Testing" the last 50 pages are given up almost entirely to the Rideal-Walker test and its modifications. For some reason not apparent, methods of chemical analysis are not dealt with at all. To those who are only interested in the practical side of the subject, the book will afford valuable guidance as to procedure, the methods in use, or which have been suggested, being impartially discussed, and the apparently conflicting results obtained by different workers with the same substance being duly recorded and, where possible, accounted for.

Disinfection is, however, still mainly an empirical process. In the case of some of the commonest preservatives it is difficult to say to what their specific action is due, or even to explain why they should act as preservatives at all. As the authors put it: "The manner in which the normal metabolic functions" of the organisms "are destroyed by the germicide is unknown."

Nevertheless, the mass of observations and the many interesting speculations, here collected and recorded, justify the expectation that some definite laws governing the relations between germicides, antiseptics and organisms will ultimately emerge. Fortunately, on the practical side, most of the factors on which successful disinfection depends are now fairly well defined, and are discussed by the writers in a most interesting and suggestive manner, and the difficulties arising under working conditions and their probable causes, both chemical and physical, are fully set forth. The question of the standardisation of disinfectants, with which one of the authors is so closely associated, is treated with a commendable freedom from bias, and full recognition is accorded to the defects, some of them perhaps insuperable, inherent in the present methods, and to the suggestions which have been made with the object of remedying them.

The chapter on the sterilisation of water is, as would be expected, full and up-to-date, and the valuable experience gained during the war receives here, as in other parts of the book, due recognition. From the practical standpoint some illustrations of the various "dosing" devices which are employed would have been valuable. On the purely theoretical side the subject is presented in a manner which, if not exactly new, has hardly hitherto been attempted in the older text-books, and the many physical and chemical problems arising in connection with it are dealt with in the light of modern theories.

We have failed to discover any serious errors, but the attribution to Leeuwenhoek of the invention of the microscope can hardly be accepted, in view of the much stronger claims of Cornelius Drebbel, Zacharias Jansen, Galileo, and Lipperhay.

There are a few misprints, of which the following may be noted:—"Naturalised" for "neutralised" (p. 76), "*S. pyg. aureus*" for "*S. pyog. aureus*" (p. 88), "aleinist" for "alienist" (p. 135), "adsorbant" (p. 165), "McConckey" for "MacConkey" (p. 288), and "mumber" for "number" (p. 297); but a more serious blemish is the obvious evidence of haste in production in the form of slipshod writing and a tendency to use ultra-scientific phraseology where simpler language might be employed. Fortunately the authors' meaning, though sometimes obscured, can generally be made out, but accuracy of expression is often lacking, and from the literary point of view the book leaves much to be desired.

The arrangement is excellent, and the type and paper all that could be desired.

CECIL H. CRIBB.

DICTIONNAIRE ANGLAIS-FRANÇAIS-ALLEMAND DE MOTS ET LOCUTIONS INTERESSANT LA PHYSIQUE ET LA CHIMIE. By R. CORNUBERT. Paris: Dunod. 1922. Price 42fr. net.

This dictionary, as originally published, dealt only with French and German physical and chemical terms; it has now been enlarged so as to include the corresponding English words. Its plan is simple and effective, and makes reference an easy matter. On each page the entries are arranged in three columns—English,

French and German—with the key words printed in bolder type according to their alphabetical position in any of the three languages. For example, when a word is practically the same in each language, such as, for instance, "Refractometric," there are three parallel entries in bold type. Again, "Eau" is printed prominently in its proper position under "E," whilst "Water" and "Wasser" in the parallel columns are in small type; and so on. This arrangement not only saves space, but is also much more convenient than having each language placed in a separate section of the book.

The list of chemical and physical terms for which the respective equivalents are given is copious; it includes chemical substances, apparatus and parts of apparatus, physico-chemical measurements, and details of processes involved in chemical and physical methods. There are also very full lists of English and German abbreviations, but the English student will miss the list of the analogous French abbreviations; it would be an improvement if these were added in the next edition.

The English translations of the French and German terms are, in general, excellent, especially in the case of the more technical words and phrases, but for some of the more common terms unusual, obsolete, or even non-existent words are given. For instance, "to degradate" would possibly have been a useful verb, if it had ever been acclimatised. "Fugacious," it is true, is to be found in English dictionaries, but, fortunately, the influence of Dr. Johnson on the English language has waned, and we now shrink from using such a word.

Apart from a censorship of strange words, more attention might, with advantage, also have been given to the proof-reading of the English columns, for there are numerous misprints, some of which may puzzle a French or German student. For example, we find "purping nut oil" as the translation for "Curcasöl," and a remarkable hybrid "dog-cat" as the equivalent for "graisse-de-chien."

But all these are minor blemishes, which can be readily removed from the next edition, and which do not materially detract from the value of the work; and, regarded as a whole, the dictionary may be thoroughly recommended as a trustworthy aid to the English chemist.

When the enormous labour involved in collating the words and phrases in the three languages is taken into consideration, the price at which the book is published must be regarded as exceptionally reasonable.

EDITOR.

Publications Received.

REPORTS ON THE PROGRESS OF APPLIED CHEMISTRY. SOCIETY OF CHEMICAL INDUSTRY. Vol. VI. 1922. Pp. 638. Price 7s. 6d. to Members of the Society; 12s 6d. to non-members.

THORPE'S DICTIONARY OF APPLIED CHEMISTRY. Vol. III. (Explosives to K.) Pp. 735. London: Longmans, Green & Co. Price 60s. net.

CHEMICAL EXAMINATION OF WATER, SEWAGE, FOODS AND OTHER SUBSTANCES. By J. E. PURVIS, M.A., and T. R. HODGSON, M.A. Second Edition. Pp. 346. Cambridge University Press. Price 20s net.

SOME PHYSICO-CHEMICAL THEMES. By ALFRED W. STEWART, D.Sc. Pp. 419. London: Longmans, Green & Co. 1922. Price 21s. net.

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION. FORTY-FOURTH ANNUAL REPORT (for 1920). Public Document No. 24. New Haven. 1921.

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The Institute of Chemistry of Great Britain and Ireland.

PASS LIST.

EXAMINATIONS: APRIL, 1922.

THE following candidates passed the examination for the Associateship (A.I.C.): *In General Chemistry*: Lawrence James Patrick Byrne, B.Sc. (Birm.), University of Birmingham; Guy William Carr Gardener, King's College, London, and Sir John Cass Technical Institute; Edward Thomas Illing, B.Sc. (Lond.), Birkbeck College; Hugh Trefor Jones, B.Sc. (Wales), University College of Wales, Aberystwyth; John Leonard Raynes, B.Sc. (Lond.), University College, Nottingham; Frederick Stanley Shadbolt, Sir John Cass Technical Institute and Birkbeck College. *In Branch (d)*: *Organic Chemistry*: Henry Naylor, Blackburn Municipal Technical College; Reginald John Philip, Birmingham Municipal Technical School. *In Branch (g)*: *The Chemical Technology of Sulphuric Acid and its By-Products*: Alexander Sanders, Royal Technical College, Glasgow.

The following Associates passed the examination for the Fellowship (F.I.C.): *In Branch A, section II., Metallurgy*: Frank Hargreaves, A.R.S.M., D.I.C. *In Branch E, the Chemistry (including Microscopy) of Foods and Drugs and Water*: Arthur Chapman Barnes, B.Sc. (Manc.); John Edward Byles, B.Sc. (Manc.).