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COMPOSITIONAL CHANGES IN ZAGLOUL DATES THROUGHOUT THE DIFFERENT STAGES OF MATURITY

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The maturation period of Zagloul dates, representing the red-type of fresh dates, was classified into four stages : ' green ', ' turning ', ' fully coloured ' and ' discoloured ' instead of the three stages designated by the Mesopotamian native terms of ' Kimri ', ' Khalal ', and ' Rutab '. Analyses of dates during the maturation period are presented, from which it is seen that total sugars increased up to the ' full coloured ' (edible) stage and thereafter decreased. Changes in the other constituents are briefly discussed.

Different stages of maturity are recognized in the various types of dates which are classified as fresh, semi-dry and dry dates. However, the climatic conditions may increase or decrease the number of such stages for the same variety. The Mesopotamian native terms have been used conventionally by many investigators. Dawson[1] reported that four stages of maturity are observed in Mesopotamia, viz., ' Khimri ' the green stage, ' Khalal ' which includes development in size and change in colour to red or yellow, ' Rutab ' (which is the Arabic word for moist) characterized by a darkening of the colour to dirty brown or black, and by a squashy texture and loose skin, and ' Tamar ', meaning dates of low moisture content, described by Dawson as the perfect dates.

Fattah,[2] on his study of the Mesopotamian dates in California, combined the first two stages into one termed ' green or immature dates ', which ends when the fruit begins to change colour. The other stage is ' medium ripe ', at which the fruit loses most of its astringent taste and acquires a soft texture and dark colour. Dates at this stage are sold in Mesopotamia for immediate consumption, whilst the mature or ripe fruit, characterized by a high total solids content, is packed as semi-dry dates.

Haas & Bliss[3] characterized the first two stages of Deglet Noor variety analytically. The first stage is associated with a rapid increase in size and fresh weight, increase in reducing sugars, high moisture content, low pH, accumulation of almost all 80% alcohol insoluble solids, and green colour. The second stage is characterized by rapid accumulation of dry matter, especially sugars, rapid increase in sucrose and decrease in reducing sugars, a gradual increase in pH, a decrease in moisture content, and in size of fruit and development of the characteristic red colour of Deglet Noor dates.

Rygg[4] suggested dividing the stages of development into three rather than two. In the case of ' Khimri ', two stages should be distinguished and characterized as follows : (*a*) rapid increase in fresh weight and volume, rapid accumulation of reducing sugars, low but increasing rate of accumulation of total sugars and total solids, lowest pH, moisture content high but not quite equal to that in the next period, and green colour ; (*b*) reduced rate of gain in fresh weight and volume, greatly reduced rate of accumulation of reducing sugars, considerable reduction in the already low rate of accumulation of total sugars, high moisture content, slightly increased pH, and green colour.

The same investigator characterized the ' Khalal ' stage by the continued decrease in rate of gain in fresh weight, the actual weight possibly even decreasing late in the period ; low rate of gain in reducing sugars ; rapidly increasing rate of accumulation of sucrose, total sugars, and total solids ; decreasing moisture content, continued decrease in pH, and development of red or yellow colour according to variety.

The Arab scientists classify dates as ' hot ' and ' cold ' depending on their sugar contents. ' Hot ' dates are usually considered the sweetest (Popenoe[5] and Fattah[2]). Dates are also classified chemically as ' cane sugar ' and ' invert sugar ' dates according to the predominant type of sugar in their ripe stages (Vinson[6]). The proportion of invert sugar (calculated on total sugars) may be as high as 100% in ' Barttee ', an ' invert sugar ' variety, or only 30–40% in Deglet Noor variety (only in the ripe stages) (Rygg[4]).

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Sinclair *et al.*[7] reported that the nitrogen content of Deglet Noor dates ranged from 0·25 to 0·32% on fresh weight basis, whilst Capertini[8] found that the percentage of ether extract ranged from 0·29 to 0·53 on the fresh weight basis. The ash content varies greatly from one variety to another, being 3·38 and 2·14% in Khadrawi and Deglet Noor varieties, respectively (Haas[9]). The tannin content of ripe dates ranges from 0·02% in Deglet Noor to 1·8% in Duck El Badan dates (Fattah[2]).

Experimental

Two trees from the orchard of the Faculty of Agriculture, Giza, were used for sampling. Samples were taken from each tree and were separately analysed. The results of the two trees are reported in this investigation under the names of Zagloul I and Zagloul II.

In Egypt, palm trees are usually artificially pollinated three times during March and April. Because of this, the individual fruits of one bunch are not all of the same maturity, and consequently are of different sizes. This wide variation in size and development necessitated taking fruits of the same size at the different dates of sampling. When samples were picked at random, in the first season, great fluctuations were observed in the results. The results of that season were therefore disregarded.

Samples of nearly the same size were taken from different bunches and from scattered positions at an interval of one week from the 25th of June until the 7th of October.

Sampling was always done at 7–7.30 a.m. and the fruits were exposed to indirect sunlight on the day they were picked, which prevented the introduction of variation due to different degrees of desiccation during days of varying intensity of heat. In the tree named Zagloul II no more fruits were available for analysis after 30th of September, as the fruits were injured by insects.

The maturation process in Zagloul dates is classified in this work into four stages according to colour changes. The proposed stages of maturity are ' green ', ' turning ', ' fully coloured ' and ' discoloured ' instead of the Mesopotamian names ' Kimri ', ' Khalal ' and ' Rutab '.

Analyses were made during maturation of the fruit, of total solids, reducing sugars, sucrose, total sugars, starch, protein, ether extract, tannins and ash.

The official methods as described by the Association of Official Agricultural Chemists[10] were used for all the analyses made, and in the whole course of analysis duplicate samples were used.

Results

Tables I and II show the results of the different constituents of the date fruit throughout maturation.

Effect of maturity on the moisture content of the date fruit

Hilgeman & Smith[11] considered ripening in dates as a matter of dehydration. Some varieties of dry dates contain as low as 10% moisture, while the semi-dry ones contain about 25%, in the tree-ripe stage (Aref[12]). The moisture content of the same variety is also largely governed by climatic conditions. Tree-ripe ' Khadrawi ' contains about 30% moisture when grown in America and only 15% when grown in its homeland Mesopotamia (Aref[12]). In this investigation, the percentage of total solids during the green stage was around 15% while a rapid increase was observed towards the end of the ' turning ' stage.

Formation and accumulation of sugars in dates

The proportion of sugars in the dry matter has been used as an indication of maturity in dates (Rygg[4]) as sugars constitute about 80% of the dry matter in ripe dates. Table I shows that, during the ' green ' and ' turning ' stages, the reducing and non-reducing sugars increased, while at the end of the ' fully coloured ' stage and beginning of the ' discoloured ' stage the amount of total sugars reached its maximum. The ' Rutab ' or ' discoloured ' stage was accompanied by a considerable decrease in total sugar content, most of which was due to loss of sucrose, part of which was inverted.

Ether extract

The percentage of ether extract of Zagloul dates was in agreement with the work of Winton[13] and Capertini.[8] The increase in the ether extract content during the ' turning ' and ' coloured ' stages may be due to the thin waxy layer which is usually formed on the rind at those stages of maturity.

Other analytical results

The reported protein contents agree with the results of Atwater & Bryant,[14] Capertini[8] and Sinclair *et al.*,[15] and those of ash content with the work of Haas.[9] Tannins were determined in the edible stages only (' fully coloured ' and ' discoloured '), and the results agree with the findings of Fattah[2] on Zahidi and Deglet Noor dates. The pH value was determined in the pressed out juice in the edible stages only. An increase in the pH was observed with softness and discoloration of the fruit. The results agree with the work of Rygg.[4] The total soluble solids content (determined by refractometer) decreased slightly and gradually throughout the ' discoloured ' stage, although the percentage of total solids was increasing. This may be due to the loss of sugars at that stage.

Discussion

The four stages of maturity herein employed, namely ' green ', ' turning ', ' fully coloured ' and ' discoloured ', have been considered by Fattah[2] as two and by Haas & Bliss[3] and Rygg[4] as three stages. However, the ' Khalal ' stage is actually two stages rather than one, because the fruit is only edible in the ' fully coloured ' stage. Furthermore, at the latter stage, the astringent taste disappears and sucrose accumulates at the expense of the reducing sugars (Table I). This accumulation adds to the palatability of the fruit as sucrose is 34% sweeter than glucose according to Aref.[12] At the edible stage, the percentage of sucrose and reducing sugars is almost the same (Table I), consequently the Zagloul variety can be considered neither as an ' invert sugar ' nor a ' sucrose ' type of date.

Table I

Composition of Zagloul dates (average Zagloul I and II) at different stages of growth.

Date of sampling	Stage	Dry matter	Results expressed on the dry weight of the material						
			Total sugars	Reducing sugars as invert sugar	Sucrose	Starch	Ether extract	Protein	Ash
		%	%	%	%	%	%	%	%
June 25	' Green '	14·82	42·67	41·66	1·01	11·11	2·17	7·77	3·61
July 2	,,	15·17	46·58	42·92	3·63	10·80	2·06	7·84	3·60
8	,,	15·25	47·31	43·25	4·06	10·09	2·01	7·73	3·53
15	,,	15·35	49·10	44·52	4·58	10·15	1·92	7·03	3·44
22	,,	15·47	50·82	44·94	5·88	9·29	1·94	6·90	3·32
29	' Turning '	15·57	52·70	45·34	7·36	8·42	1·89	6·84	3·17
August 5	,,	15·69	56·01	45·44	10·57	7·85	1·87	6·63	3·11
12	,,	15·88	63·99	51·31	12·68	7·45	2·23	6·30	3·11
19	,,	16·06	65·81	53·00	12·81	6·60	2·76	5·69	3·10
27	,,	16·71	67·07	53·78	13·28	5·30	2·98	4·63	3·26
September 3	,,	17·83	68·72	54·82	13·90	4·72	3·25	4·26	3·25
10	,,	21·17	77·79	58·03	19·76	4·16	3·35	4·15	3·00
17	,,	28·47	81·36	59·74	21·32	3·35	3·34	3·96	2·85
24	' Full colour '	35·67	80·84	42·38	38·46	3·21	3·53	3·60	2·43
30	,, ,,	38·32	84·27	35·79	48·47	2·97	3·85	3·00	2·37
October 7	Discoloured	39·46	86·90	43·32	43·58	3·35	3·43	3·20	2·25
9	50% soft	40·04	64·46	52·07	12·39	3·11	3·32	2·12	2·24
12	75% soft	41·13	61·19	54·41	6·78	3·07	3·25	3·10	—
15	100% soft	44·57	59·33	53·28	6·05	3·02	3·30	3·09	2·01

Sugars are the main components of dates, as they constitute approximately 85% of total solids (Table I). If the sugar content of the fruit is used as an index of ripeness, the ' fully coloured ' stage should be considered as the ripe stage and consequently the ' discoloured ' stage (' Rutab ') would be an over-ripe stage. In the ' Rutab ' stage, the total sugar content decreases (from 84 to 59%, Table I) and the fruit loses its characteristic colour, and the skin

Table II

Analyses of Zagloul dates at the edible stage

Stage	pH	Total soluble solids by refractometer %	Tannins (fresh weight basis) %	Tannins (dry weight basis) %
' Full colour '	6·00	32·50	0·13	0·33
' Discoloured '	6·10	32·50	0·12	0·30
50% soft	6·15	32·00	0·11	0·27
75% soft	6·20	32·00	0·10	0·24
100% soft	6·40	31·80	0·09	0·20

becomes wrinkled and loose. At the end of this stage, which lasts only one or two days, the flavour is insipid and the fruit spoils rapidly by souring or moulding. Rygg[4] in the case of Deglet Noor dates, considered the ' Rutab ' stage as a premature stage, as the fruits are usually consumed in the ' Tamar ' stage ; this stage does not exist in fresh dates. The Zagloul variety is usually consumed in the ' fully coloured ' stage as the fruit becomes rapidly insipid in the ' Rutab ' stage.

Summary

1. The Zagloul date variety, representing the red type of fresh dates, was studied throughout maturation.

2. The constituents of this variety were analysed weekly for total solids, reducing and non-reducing sugars, starch, protein, ether extract, tannins and ash.

3. The maturation period was classified into four stages : ' green ', ' turning ', ' fully coloured ' and ' discoloured ', instead of the three Mesopotamian native terms of ' Kimri ', ' Khalal ' and ' Rutab '. The ' Tamar ' stage did not exist in this variety.

4. Throughout maturation, total solids and total sugar contents increased while starch, protein and ash contents decreased.

5. Total sugars increased up to the ' full coloured ' (edible) stage and decreased in the ' discoloured ' (' Rutab ') stage.

6. The ratio of reducing to non-reducing sugars varied during maturation.

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STUDIES ON PROTEIN HYDROLYSIS. IV.*—Further Observations on the Taste of Enzymic Protein Hydrolysates†

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Enzymic hydrolysates have been prepared from α-, β- and γ-fractions of the casein complex by use of trypsin, and from commercial muriatic casein by use of crystalline trypsin and of crystalline chymotrypsin. These hydrolysates had a bitter taste.

Muriatic casein was incubated with dilute sodium hydroxide so as to split off orthophosphate before digestion with ' Protease ' (Takamine). Muriatic casein was also treated with crude proteolytic enzyme preparations and the degree of liberation of orthophosphate was measured. In these experiments the taste of the hydrolysates was improved in parallel with the liberation of orthophosphate. However, a similar improvement in taste was not observed when the orthophosphate was removed by use of intestinal phosphatase following the tryptic hydrolysis.

A series of fractionations of a tryptic casein hydrolysate yielded a product that had an extremely bitter taste. Chromatographic and electrophoretic studies have suggested that this material was a single polypeptide. Use of 2 : 4-dinitrofluorobenzene failed to reveal the presence of N-terminal amino-acids ; the material yielded leucine, valine, and glutamic acid on hydrolysis with carboxypeptidase.

Introduction

It has been reported previously[1] that the taste of enzymic protein hydrolysates was found to vary with the type of protein and with the enzymic preparation used in their preparation. The products from gelatin and egg albumin, for example, had a bland taste, whereas those from casein and lactalbumin were somewhat objectionable and bitter. Of the different proteolytic enzyme preparations used in the preparation of casein hydrolysates, ' Rhozyme P11 ' (Rohm & Haas) was found to yield products of the most acceptable taste.

Treatment with carbon greatly improved the taste of enzymic casein hydrolysates.[1] However, this method of improving the taste was not considered to be of practical importance because of the simultaneous removal of a large proportion of the tryptophan. A very bitter-tasting fraction that contained polypeptides was eluted from the carbon which had been used in this carbon treatment.

The aims of the experiments reported in the present paper were (*a*) to find means of improving the taste of enzymic casein hydrolysates and (*b*) to gain more precise information on the nature of the bitter-tasting fraction which was isolated from the carbon black.

Experimental

Hydrolysates prepared from different fractions of the casein complex

It is well recognized that casein is not a single protein, but comprises at least three components.[2] There was the possibility, therefore, that one of these three components might be the main source of the bitter taste which is characteristic of enzymic casein hydrolysates.

The casein fractions commonly known as α-, β- and γ-casein were prepared according to the directions of Warner[3] and of Hipp *et al.*[4] The following yields were obtained from 15 gallons of skim milk : α-casein 10·6 g. ; β-casein 6·0 g. ; γ-casein 3·3 g. The aspartic acid and proline contents of the three fractions were determined by microbiological assay. All determinations were performed on air-dried samples. Table I shows the results of these determinations and also lists the results of similar determinations reported by Gordon *et al.*[5]

One g. of each fraction was suspended in 10 ml. of water and the pH was adjusted to 7·5. Trypsin (0·1 g.) was added to the resultant casein dispersion and the mixture was then incubated at 37° under toluene for 24 hours. At the end of the digestion period the hydrolysates were analysed for total nitrogen and amino-nitrogen and were then freeze-dried. The dried products were tasted by a panel of four persons. The results reported in Table II show that the three fractions were hydrolysed to approximately the same degree and that the three hydrolysates were bitter in taste.

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Table I

Analysis of casein fraction

Protein preparation	Aspartic acid	Proline
α-casein	8·1 (8·4)*	7·4 (8·2)*
β-casein	5·1 (4·9)*	15·1 (16·0)*
γ-casein	9·3	17·7 (17·0)*

* Results reported by Gordon *et al.*[5]

Table II

Comparison of trypsin hydrolysates prepared from α-casein, β-casein and γ-casein

Protein preparations	Amino-N as % of total N	Taste
α-casein	42·6	Bitter
β-casein	41·4	Bitter
γ-casein	42·1	Bitter

Hydrolysis of casein with crystalline chymotrypsin and crystalline trypsin

In the previous work[1] on the taste of enzymic casein hydrolysates, the enzyme preparations which were used were mixtures of different proteolytic enzymes. It was of interest, therefore, to observe whether or not a bitter-tasting product would be formed when casein was hydrolysed with crystalline enzymes.

Two 10-g. samples of commercial muriatic casein were suspended in 100-ml. portions of water. The reaction of one suspension was adjusted to pH 7·5 and the other to pH 8·0, and 25 mg. of crystalline chymotrypsin and of crystalline trypsin were added to the suspensions, respectively. The mixtures were incubated at 37° under toluene for three days. Samples were taken at convenient time intervals and were analysed for amino-nitrogen and total nitrogen. The samples were then freeze-dried and tasted. The samples were rated as to taste according to the method outlined previously.[1] The results reported in Table III are similar to those obtained previously using crude enzyme preparations.[1]

Table III

Taste of casein hydrolysates prepared with crystalline enzymes

Digestion time, h.	Amino-N as % of total N		Taste ratings *	
	Crystalline chymotrypsin	Crystalline trypsin	Crystalline chymotrypsin	Crystalline trypsin
3	8·5	10·5	1 (bitter)	1 (bitter)
12	8·6	10·7	2 (bitter)	2 (bitter)
24	10·2	11·0	3 (bitter)	3 (bitter)
72	10·8	17·1	4 (bitter)	4 (bitter)

* Most palatable member of any series is rated as 1, next most palatable as 2, and so on for the series of samples concerned. Each series is rated independently.

Hydrolysis of dephosphorized casein

Previous work[1] had shown that casein and lactalbumin gave bitter-tasting products on enzymic hydrolysis, whereas those from the other proteins (gelatin, egg albumin, soya protein fibrin, wheat gluten) were not bitter. As the two former proteins contain organic phosphorus it was of interest to enquire into the possibility that a phosphopeptone might be responsible for the bitter taste. Moreover, in the tryptic hydrolysis of casein there is a certain degree of coincidence between the time of maximum release of soluble organic phosphorus[6] and the time of maximum bitter taste[1] production.

Rimington & Kay[6] showed that the phosphorus in casein could be liberated as orthophosphate by digestion with dilute alkali. Following the procedure of these workers, a mixture of 50 g. of casein and 500 ml. of 0·2N-sodium hydroxide was incubated at 37° for 24 hours. The casein was precipitated with dilute hydrochloric acid and washed on a Büchner funnel with several portions of water. The product was divided into two equal parts. One part was incubated with 250 ml. of 0·2N-sodium hydroxide at 37° for an additional 12 hours. The product

was recovered as previously described. Five g. of each sample were suspended in 50-ml. portions of water to which was added 0·1 g. of ' Protease ' (Takamine). The mixture was incubated at 37° under toluene for a period of four days. At the end of the digestion period the hydrolysates were freeze-dried and tasted. The casein which had been heated with the alkali for a period of 36 hours gave a hydrolysate which had no bitter flavour and the hydrolysate from casein treated for 24 hours was very slightly bitter.

Phosphatase activity of trypsin (National Biochemicals) and ' Rhozyme P11 ' (Rohm & Haas).— One hundred g. of casein were suspended in 100 ml. of water and the pH was adjusted to 8·0 with sodium hydroxide solution. Two g. of trypsin were added to the casein dispersion and the mixture was incubated at 30° under toluene for seven days. One-hunded-ml. samples were withdrawn at various time intervals and were analysed for amino-nitrogen, total nitrogen, inorganic phosphorus and total phosphorus.[7] To determine inorganic phosphorus, 2 ml. of filtered hydrolysate were diluted to 100 ml. with distilled water. A suitable aliquot portion was taken for the phosphate determination. To determine total phosphorus, 2 ml. of the filtered hydrolysate were digested in a 30-ml. micro-Kjeldahl flask with 3 ml. of concentrated sulphuric acid and 1 ml. of 70% perchloric acid until complete decomposition of the organic matter was effected. The solution was diluted to 100 ml. and a suitable aliquot portion taken for analysis. The remainders of the 100-ml. samples, which were taken for analyses, were freeze-dried and then tasted. The results of this experiment are shown in Table IV.

The above experiment was repeated using the enzyme preparation ' Rhozyme P11 ' (Rohm & Haas). With this enzyme preparation the pH of the casein suspension was adjusted to 7·5. It will be noted in Table IV that the improvement in the taste of the enzymic casein hydrolysates paralleled the liberation of inorganic phosphorus.

Table IV

Phosphatase activity of two commercial proteolytic enzymes

Digestion time, h.	Amino nitrogen*	Inorganic phosphorus†	Taste ratings
	Trypsin		
1	24·6	22·6	1
6	31·8	23·0	2
12	35·4	23·4	3
24	39·0	23·3	7
48	44·3	23·6	6
96	46·0	25·0	5
168	47·0	27·0	4
	Rhozyme P11		
1	15·5	12·2	5
48	47·4	37·2	4
120	57·1	44·2	3
192	59·6	50·6	2
360	60·4	56·3	1

* Amino-N as % of total N
† Inorganic P as % of total P

Effect of intestinal phosphates on the taste of tryptic hydrolysates.—The results of the above experiment showed that the liberation of inorganic phosphorus paralleled the improvement in taste of the casein digests. In the following experiments the phosphorus was liberated as phosphate by the use of intestinal phosphatase and the taste-rating of the products was determined.

Twenty g. of finely divided, reprecipitated casein was added to 200 ml. of water and the mixture vigorously stirred. The suspension was divided into two equal portions both of which were treated as follows: After adjustment of the pH to 7·0 with 20% sodium hydroxide the solutions were autoclaved at 15 pounds pressure for 15 minutes, and the pH then adjusted to 8·0 by the aseptic addition of 5% sodium hydroxide. One g. of trypsin was dissolved in distilled water and the resulting solution filtered through a Seitz bacteriological filter. The filtrate was added aseptically to the casein suspension in a room flooded with ultra-violet light, and the

mixture incubated at 37° for 24 hours. At the end of this period 25-ml. samples were taken for nitrogen and phosphorus analyses and the remainder of the solutions autoclaved at 15 pounds pressure for 15 minutes to inactivate the enzymes. The reaction of the hydrolysate was then adjusted to pH 8·5 with sodium hydroxide solution. One portion of the original casein dispersion so treated was used as a control (No. 2) and to the other (No. 1) were added 1000 Schmidt and Thannhauser units[8] of intestinal phosphatase (Armour Laboratories). These solutions were incubated at 37° and samples were taken for analyses at various time intervals. Each sample was analysed for nitrogen and phosphorus and a portion of each sample was freeze-dried and tasted. The results are given in Table V. The data show that the bitter taste of the tryptic hydrolysate was not appreciably changed by the phosphatase treatment.

Table V

Digestion time, h.	Hydrolysate	Amino-nitrogen*	Inorganic phosphorus†	Taste ratings
0	No. 1	26·6	13·6	Bitter‡
	No. 2	26·8	13·1	,,
12	No. 1	26·7	19·7	,,
	No. 2	27·8	56·5	,,
24	No. 1	26·4	21·1	,,
	No. 2	28·1	68·5	,,
48	No. 1	26·6	23·2	,,
	No. 2	28·6	88·6	,,

* Amino-N as % of total N
† Inorganic P as % of total P
‡ There was no detectable difference between the intensity of the bitter taste of the treated and of the non-treated samples

Separation of a bitter-tasting fraction from enzymic casein hydrolysates by carbon treatment

The method reported previously[1] was used to isolate approximately 10 g. of the bitter-tasting fraction from a tryptic hydrolysate of casein. The reddish-brown gum (Fraction A), which was obtained on evaporation of the alcohol used in the washing of the carbon, was readily soluble in *iso*propanol, butanol and ethanol, but less soluble in water. The material gave a strong biuret reaction, and a qualitative test for reducing sugar and aldehydes was negative both before and after the material had been treated with 0·5N-sulphuric acid at 100° for 4 hours. The presence of a small amount of phosphorus and some amino-acids was detected in this fraction.

Fractionation of Fraction A by the use of ion-exchange resins.—Fifty g. of a cation-exchange resin (Amberlite IR-100), in the acid form, was placed in a glass tube 1·6 cm. in diameter and 80 cm. long. The tube was fitted with a sintered glass disk and a stopcock. Approximately 3 g. of fraction A, dissolved in 20 ml. of water, was added to the column. The column was then washed with 500 ml. of distilled water and the effluent was collected at the rate of 200 ml. per hour. The first 50 ml. which was collected was colourless and contained no appreciable amount of nitrogen. During the collection of the next 50 ml. the effluent became reddish-brown in colour. After the collection of a further 50 ml. the effluent became colourless again and no longer contained any appreciable amount of nitrogen. The coloured portion of the effluent was evaporated, under reduced pressure, to a small volume (Fraction B). The resulting solution contained approximately 20% solids. It was dark brown in colour, gave a strong biuret reaction and possessed an extremely bitter taste. Qualitative paper chromatographic analysis of the solution indicated that no free amino-acids were present.

A 0·5-ml. portion of Fraction B was sealed in a glass tube along with 0·2 g. of barium hydroxide, and heated at 100° for 24 hours. At the end of the heating period the barium was removed from the hydrolysate as barium sulphate. The resulting solution was examined by paper chromatography and was found to contain the following amino-acids: aspartic acid, glutamic acid, glycine, alanine, valine, leucine, serine, phenylalanine, tyrosine, proline, methionine and arginine.

Another sample of fraction B was hydrolysed with hydrochloric acid and the hydrolysate

also examined by paper chromatography. The same amino-acids, with the addition of threonine, were detected in this hydrolysate as were detected in the barium hydroxide hydrolysate.

In Fraction B it was found that the amino-nitrogen was 8·88% and the amide nitrogen was 7·15% of the total nitrogen.

Determination of the N-terminal residues in Fraction B.—A small amount of Fraction B was treated with 2 : 4-dinitrofluorobenzene (DNFB) according to the method of Sanger.[9] The dinitrophenyl (DNP) peptides were hydrolysed with 20% hydrochloric acid and the amino-acid derivatives were isolated by ether extraction. It was necessary to wash the ether extract with dilute hydrochloric acid to remove the free amino-acids which were extracted from the hydrolysate. The DNP-amino-acids were decomposed with ammonia according to the directions of Lowther,[10] and the free amino-acids identified by paper chromatography. The amino-acids leucine, valine, alanine and aspartic acid were identified.

Fractionation of Fraction B by paper chromatography.—One drop containing approximately 0·01 ml. of Fraction B was placed at one end of a strip of Whatman No. 1 filter paper, three-quarters of an inch wide and 18 inches long. The chromatogram was developed in butanol–acetic acid for 24 hours and was then dried in vacuum at room temperature, for a period of 4–5 days. Four fluorescent spots were located when the chromatogram was examined under ultra-violet light. The chromatogram was cut transversely into strips 1 cm. in width, and the strips were numbered beginning at the solvent front. Each strip was examined under ultra-violet light and each tasted. The results reported in Table VI show that the fluorescent spot with the high R_F value contained a bitter-tasting material.

When phenol was used as the solvent, a single fluorescent spot was located close to the solvent front. The solvent system collidine–lutidine gave a continuous streak from the original spot to the solvent front.

The following procedure was used to isolate a larger quantity of the material which formed the bitter, fluorescent spot near the butanol–acetic acid solvent front. Sixteen portions of Fraction B (each 3 mg.) were applied at 1½ in. intervals, 2½ in. from one end of the 18 in. side of a 11 in. × 18 in. Whatman No. 3 mm. filter paper and the chromatogram was de veloped in butanol–acetic acid. The fluorescent spots which were located near the solvent front were cut from the rest of the chromatogram. One end of this strip was placed in a glass trough containing the butanol–acetic acid solvent and the other end, which was cut to form a point, was placed inside a 5-ml. beaker. The strip was eluted in this way until it no longer fluoresced under ultra-violet light.

Thirty strips were prepared and eluted with butanol–acetic acid solvent. The combined eluate was evaporated to a small volume, a few ml. of water were added, and the evaporation was repeated. Finally, the material was dried over phosphorus pentoxide in a vacuum desiccator for 24 hours. A light brown product (Fraction C), containing 3·65% nitrogen, was obtained.

A sample of Fraction C was heated at 100° for 24 hours in a sealed tube, with 5·7N-hydrochloric acid. The excess hydrochloric acid was removed from the hydrolysate by evaporation in vacuum and the amino-acids were identified by two-dimensional paper chromatography. The following amino-acids were identified: glutamic acid, aspartic acid, glycine, alanine, valine, tyrosine, proline, leucine and/or *iso*leucine. No tryptophan was detected in a similar hydrolysate prepared with barium hydroxide.

Another sample of Fraction C was heated under reflux for 3 hours with 1N-hydrochloric acid. The excess hydrochloric acid was removed from the hydrolysate by evaporation under reduced pressure. The residue gave negative results when tested for carbohydrate material[11] and for amino sugar.[11]

Fractionation of Fraction C.—An attempt was made to fractionate Fraction C by paper chromatography using the solvent systems phenol–water and collidine–lutidine–water. Only one spot was detected on the chromatogram prepared with these solvents. Using the paper electrophoretic technique, two fluorescent bands were detected when a buffer solution at pH 4 was used, and only a single fluorescent band was detected with a buffer solution at pH 10. The electropherogram prepared at pH 4 was treated with Sudan Red, which stains fats and fatty acids a red colour. The slow-moving band was stained red, while the faster-moving band remained colourless. This showed that Fraction C contains a fatty substance which might be removed by

Table VI

Chromatographic fractionation of Fraction B

Strip number	Fluorescence under ultra-violet light	Taste
1	*	Bitter
2	***	Bitter
3	****	Very bitter
4	***	Very bitter
5	**	Bitter
6	*	Bitter
7		Bitter
8		
9		
10		
11		
12	*	Slightly bitter
13		
14	**	Slightly bitter
15	**	Slightly bitter
16		
17		
18		
19		
20	*	Slightly bitter
21	*	Slightly bitter
22	*	Slightly bitter
23	*	Slightly bitter
24		
25		
26		
27		

NOTE: * denotes very weak; ** weak; *** medium; **** strong

ether extraction. Accordingly, a sample of Fraction C was extracted with ether in a Soxhlet type extractor. The ether extract was evaporated to dryness and a brown, non-bitter-tasting product (Fraction D) was obtained. The residue (Fraction E), which remained after the ether extraction, was very light brown in colour, possessed an extremely bitter taste and was electrophoretically homogeneous at pH 4. The weight of the residue was approximately 25% of the weight of Fraction C which was extracted. Fraction E contained 10·3% nitrogen and gave no colour with ninhydrin. This nitrogen value was not increased by further extraction of Fraction E with ether. Attempts to couple dinitrofluorobenzene with N-terminal amino-groups in Fraction E were unsuccessful. Fraction D contained no appreciable amount of nitrogen and it was not investigated further.

Isolation of peptides from a partial hydrolysate of Fraction E.—Fraction E (10 mg.) was heated under reflux with 1N-hydrochloric acid (20 ml.) for 3 hours. At the end of the hydrolysis period, the excess hydrochloric acid was removed by evaporating the solution to dryness under reduced pressure. The peptides in the hydrolysate were separated by two-dimensional paper chromatography, using the solvent systems collidine–lutidine in the first direction and butanol–acetic acid in the second direction. The peptide spots were detected either by their fluorescence in ultra-violet light or by reference to a duplicate chromatogram which had been sprayed with ninhydrin. The spots were marked and then cut from the sheet. The peptides were eluted from the filter paper by the method described by Sanger & Tuppy.[12] The eluates were evaporated to dryness and the residues were hydrolysed with hydrochloric acid to yield the free amino-acids. The amino-acids were identified by two-dimensional paper chromatography, using the apparatus described by Datta, Dent & Harris.[13] Fig. 1 shows the position of the peptide on the chromatogram and Table VII lists the amino-acid compositions of the various peptides.

(The abbreviations used for the amino-acids are those proposed by Brand & Edsal.[14]).

Action of carboxypeptidase on Fraction E.—A mixture containing Fraction E (2 mg.), carboxypeptidase (1 mg.) (3× crystallized enzyme supplied by Worthington Biochemical Sales Co., Freehold, N.J.) and water (0·5 ml.) was incubated at 37°. Samples of the mixture were taken at various time intervals, they were centrifuged and then analysed for free amino-acids by one-dimensional chromatography using buffered phenol as the solvent. Table VIII lists the amino-acids which were detected in the various samples.

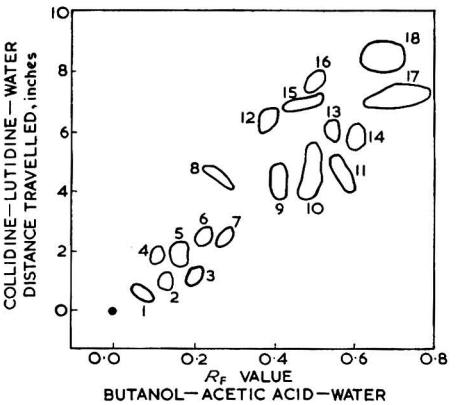

FIG. 1.—*Separation of peptides by paper chromatography*

Table VII

Amino-acid composition of peptides isolated from a partial hydrolysate of Fraction E

Spot number	Asp	Glu	Gly	Ala	Val	Leu	Pro	Tyr
1	*	**	**	*		*		
2	**	**	**	*				
3	*	***	**	*				
4		**	*	*				
5	**	***	*****	**	?	?		
6		Not identified						
7					*			
8		Not identified						
9	**	****	***	*	**	*		
10	*	***	**	*		*		
11		**	*	*	*	*		
12	*	**	*					
13		***	**	*	*	*		
14	*	**	**	*	*	***	*	
15	*	***	***	**	*	*		
16	**	*****	*****	***	*	*		
17	*	****	**	**	***	***	**	
18	**	****	***	**	****	***	****	**

? doubtful
* just detectable
** weak spot
*** medium spot
**** deep colour
***** very deep colour

Table VIII

Amino-acids liberated by action of carboxypeptidase on Fraction E

Digestion time, min.	Amino-acid detected
15	none
30	Leu
45	Leu
60	Leu
120	Leu, Val, Glu
180	Leu, Val, Glu
240	Leu, Val, Glu
360	Leu, Val, Glu
480	Leu, Val

NOTE: No other amino-acids were detected after 5 hours' hydrolysis

The concentration of leucine increased during the first hour of hydrolysis. Valine increased in concentration during the 3-, 4- and 6-hour periods while the concentration of glutamic acid remained fairly constant. The concentration of leucine in these three samples decreased and then increased again in the 6- and 8-hour sample.

Discussion

Partial hydrolysates of casein prepared with commercial proteolytic enzymes possess a bitter taste. Experiments were performed to eliminate the possibility that a particular casein fraction might be responsible for this taste, but these experiments show clearly that the three casein fractions, which were investigated, all gave the same bitter-tasting hydrolysates.

The hydrolysis of casein with crystalline chymotrypsin and with crystalline trypsin, gave products of low amino-nitrogen even after a period of hydrolysis of 72 hours. The same trend in the taste of the products produced by varying the length of the digestion period was observed, as with the crude enzyme preparations used previously.

Casein, which had been treated with dilute sodium hydroxide solution according to the method of Rimington & Kay[6] for the liberation of phosphate, gave, on hydrolysis with the commercial enzyme ' Protease ', either a very slightly bitter-tasting or a non-bitter-tasting product. The improvement in the taste of casein hydrolysates, prepared from the alkali-treated casein, which was observed after 24 hours' hydrolysis, coincided with the increased rate of liberation of inorganic phosphorus. The proteolytic enzyme preparation, ' Rhozyme P11 ', which had a much higher phosphatase activity than had the trypsin, produced a casein hydrolysate with a much less intensely bitter taste. The above experiments seemed to provide some support for the hypothesis that a phosphopeptone was involved in the bitter taste of enzymic casein hydrolysates. However, when a much higher percentage of inorganic phosphorus was liberated from a tryptic casein hydrolysate with intestinal phosphatase, than was liberated by the action of ' Rhozyme P11 ', no improvement in the taste of the hydrolysate was observed. From this observation it was concluded that the improvement in the taste of casein hydrolysates prepared from sodium-hydroxide-treated casein and by the use of ' Rhozyme P11 ', was not a function of the degree of liberation of inorganic phosphorus.

Previous work[1] showed that the bitter taste of enzymic casein hydrolysates could be greatly reduced by carbon treatment, and that a very bitter-tasting fraction containing polypeptides could be isolated from the carbon by elution with alkaline ethanol. Approximately 10 g. of this bitter-tasting fraction (Fraction A) was prepared and the free amino-acids removed from the fraction by the use of a cation-exchange resin. Qualitative chromatographic analysis of hydrolysates prepared from this purified fraction (Fraction B) showed the presence of thirteen amino-acids. The amino-acids, leucine, valine, alanine and aspartic acid were identified as N-terminal acids by the Sanger techniques; this indicated that Fraction B contained at least four polypeptide chains. The results of paper chromatographic fractionation of Fraction B to give four fluorescent spots were in keeping with this observation. However, when the fastest moving spot, which seemed to contain the bulk of the bitter-tasting ingredient of Fraction B, was further fractionated by ether extraction, the extremely bitter-tasting material (Fraction E), which was obtained, gave a negative ninhydrin reaction, and no N-terminal amino-acid could be detected by the use of 2 : 4-dinitrofluorobenzene.

A number of polypeptides was isolated from a partial hydrolysate of Fraction E. The only conclusion that may be drawn from the qualitative analysis of these polypeptides for amino-acids, is that Fraction E contained the amino-acids aspartic acid, glutamic acid, glycine acid, alanine, valine, proline, tyrosine, leucine and/or *iso*leucine.

The treatment of Fraction E with carboxypeptidase liberated the amino-acid leucine followed by glutamic acid and valine. As glutamic acid was no longer liberated after 6 hours' hydrolysis, whereas valine continued to be liberated, it would appear that the second amino-acid in the peptide chain was glutamic acid, and the third was valine. The concentration of leucine increased again in the latter stages of hydrolysis hence valine may be followed by another leucine residue.

Considering the chromatographic and electrophoretic behaviour of Fraction E it would

appear that it is a single polypeptide. The assumption that this polypeptide has a cyclic portion, with a side-chain carrying a C-terminal amino acid, is in keeping with the observed high R_F values of the material, and with the results obtained with carboxypeptidase.

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THE FLAVONOLS OF TEA

By E. A. H. ROBERTS, R. A. CARTWRIGHT and D. J. WOOD

The flavonols quercetin-3-glucoside (*iso*quercitrin), kaempferol-3-glucoside (astragalin), quercetin-3-rhamnoglucoside (rutin), kaempferol-3-rhamnoglucoside, quercetin-3-rhamnodiglucoside, and kaempferol-3-rhamnodiglucoside, previously isolated and characterized in Japanese green teas, have also been detected in unprocessed tea-leaf and black tea from North East India. From the latter sources two glycosides of myricetin, tentatively identified as the 3-glucoside and 3-rhamnoglucoside, have also been isolated.

Introduction

Flavonols have already been claimed to be present in unprocessed tea-leaf plucked in North-East India,[1, 2] and indications obtained that rutin is one of the flavonols. Flavonol glycosides are not generally oxidized in the presence of the tea oxidase[3] from which it follows that they would also be expected to occur in manufactured tea.

During the past three years the polyphenolic substances in manufactured tea have been under investigation, and incidental to this work a considerable amount of information about the flavonols in manufactured tea has been obtained. Japanese workers have also been busy in this field and have isolated and characterized several flavonols.[4–6] These latter observations are

both confirmed and extended, it having been established that all samples of tea examined contain glycosides of myricetin in addition to the glycosides of quercetin and kaempferol reported in Japanese green tea.

Experimental

Materials

Samples of green leaf were plucked and dried at the Tocklai Experimental Station, and samples of black tea from individual gardens in North-East India were drawn at the time of auctioning. Samples of dried green leaf and black tea were also obtained from the Makurazaki Black Tea Experimental Station, Japan.

Quercetin, quercitrin and rutin were purchased from Messrs. Light & Co. Ltd., myricitrin was extracted from the bark of *Myrica nagi* by the method of Rupe & Schaerer,[7] and myricetin by acid hydrolysis of this myricitrin. Astragalin, *iso*quercitrin, kaempferol-3-rhamnodiglucoside and quercetin-3-rhamnodiglucoside were presented by Dr. Nakabayashi, and kaempferol by Dr. Bate-Smith.

Paper chromatography

Paper chromatographic methods are mainly as described elsewhere,[1, 2, 8, 9] using the solvent combination butanol–acetic acid–water (4 : 1 : 2·2) followed by 2% acetic acid, and spraying with 1% ethanolic aluminium chloride to detect the flavonols. A more recent development has been to substitute 2% aqueous boric acid for the 2% acetic acid. The change of second solvent is without effect on R_F values, but the flavonols show up as bright yellow spots, intensifying under ultra-violet light, without any spray reagent being necessary. If in sufficiently high concentration, derivatives of myricetin and quercetin, but not of kaempferol, give a positive blue reaction with ferric chloride–potassium ferricyanide reagent.

Flavonols can usually be detected on chromatograms of a reconstituted juice, obtained by grinding dried green leaf with three volumes of water and centrifuging the extract. If stronger spots are required, a concentrate is prepared. The same procedure can be used both for dried green leaf and manufactured tea. The tea (15 g.) is extracted with boiling distilled water (375 c.c.) for five minutes and the extract filtered through a plug of cotton wool. The cooled filtrate is treated with excess of saturated lead acetate, and the resultant precipitate filtered off. The almost colourless filtrate is adjusted to pH 8·5 with ammonia, and further lead acetate added if necessary. The bright yellow precipitate is suspended in methanol and decomposed by hydrogen sulphide. The lead sulphide is removed and the filtrate evaporated to dryness.

A map of the spots corresponding with the flavonols found in teas is given in Fig. 1. Not all of these spots are invariably observed, even in concentrates, and some only rarely. It is probable that other flavonols may later be found, as Oshima & Nakabayashi[4] have recorded 23 flavonol spots on the chromatograms of tea extracts as against 16 recorded in this communication. Of these 16 only eight appear to be of major importance.

Identification of the aglycones

The procedure adopted was that used by Bate-Smith[10] for the detection of leuco-anthocyanins, and which is equally useful in identifying flavonol aglycones. Dried green leaf (0·2 g.) was boiled for 20 min. with 2N-hydrochloric acid (3 c.c.), and the resultant aglycones extracted with a small volume of butanol. The extract was examined by paper chromatography, using either the Forestal solvent,[10] butanol–acetic acid–water, or 2% acetic acid. The hydrolysate showed not more than three flavonol spots, the R_F values of which in the three solvents employed agreed with those of myricetin, quercetin and kaempferol. This indicated that most of the flavonols were derived from one or other of these three parent aglycones.

The aglycones associated with each of the major flavonol spots were identified chromatographically in the following way. A two-way chromatogram of a suitable concentrate was run on Whatman 3MM paper, and the spots cut out after location by ultra-violet light. The excised paper discs were extracted with 50% aqueous ethanol, the extracts concentrated to a smaller

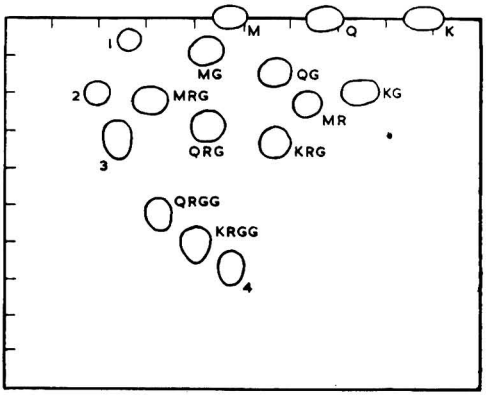

FIG. 1.—*Paper chromatogram showing flavonols occurring in tea*

The chromatogram was run first from left to right with butanol-acetic acid-water and then downwards with 2% acetic acid

M	= myricetin	QG	= *iso*quercitrin
Q	= quercetin	QRG	= rutin
K	= kaempferol	QRGG	= quercetin-3-rhamnodiglucoside
MG	= myricitrin-3-glucoside	KG	= astragalin
MR	= myricitrin	KRG	= kaempferol-3-rhamnoglucoside
MRG	= myricetin-3-rhamnoglucoside	KRGG	= kaempferol-3-rhamnodiglucoside

1, 2, 3 and 4 unidentified

volume and hydrolysed with 1N-hydrochloric acid. The resulting aglycones were extracted with ethyl acetate and concentrated until they gave a strong positive test for flavonols with ethanolic aluminium chloride. The aglycones were then identified on paper chromatograms, using the same three solvents, and with authentic samples of myricetin, quercetin and kaempferol as markers. In this way it was shown that substances 3, MG and MRG were derived from myricetin QG, QRG and QRGG from quercetin and KG, KRG and KRGG from kaempferol (letters have the meaning shown in the legend to Fig. 1).

Identification of individual flavonols

Spots M, Q and K on Fig. 1 are distinguished from the others, not only by their zero R_F in 2% acetic acid, but by their characteristic bright yellow or greenish-yellow fluorescence in ultra-violet light. This behaviour is characteristic of flavonols with an unsubstituted 3-hydroxyl group.[11] On chromatograms run with 2% boric acid as the second solvent, these spots were bright yellow in visible light. This would appear to be due to the known ability of boric acid to form yellow complexes with flavonols containing a 5-hydroxyl group. These flavonols are therefore presumed to have both 3- and 5- hydroxyl groups.

The zero R_F in 2% acetic acid (and in water) also indicates that these substances are likely to be flavonols. It will be shown in the Discussion (below) that whereas the flavonol aglycones have a zero R_F in these solvents,[2, 11] the R_F values of unglycosidated flavanones and flavanolones are appreciably greater than zero.[11, 12]

Spots M, Q and K were intensified by the addition of myricetin, quercetin and kaempferol, respectively, and taking all the above evidence into account there appears no reason to doubt that M, Q and K are to be identified with these.

Identifications of the other substances on the chromatograms are perhaps less certain. They all gave brown or yellowish-brown spots in ultra-violet light, turning yellow on exposure to ammonia vapour, behaviour indicating either the absence of a 3-hydroxyl or substitution of the 3-hydroxyl group.[11] Like spots M, Q and K they all gave visible yellow spots when 2% boric acid was the second solvent. Taking into account the identifications of the aglycones in the previous section it appears probable that these substances are 3-glycosides of myricetin, quercetin and kaempferol.

Attempts to identify flavonol glycosides by R_F values, or by intensifications of spots following addition of known substances, may lead to false conclusions, as the R_F value is not necessarily

altered by a variation in the nature of the attached sugar group. Thus it was shown by Siegelman,[13] and confirmed in this laboratory, that the 3-galactoside and 3-glucoside of kaempferol were not separated from each other by any of the usual solvents.

The observed intensifications of spots QG, KG, QRG, QRGG and KRGG by additions to the concentrates of *iso*quercitrin, astragalin (kaempferol-3-glucoside),[14] rutin, quercetin-3-rhamnodiglucoside and kaempferol-3-rhamnodiglucoside, do not therefore constitute proof that these substances occur in the samples of tea studied. However, as the nature of the aglycone has in each case been established, and as these substances have all been shown to be present in teas produced in Japan, it does not seem unreasonable to accept the identifications in these cases.

Identification of KRG as kaempferol-3-rhamnoglucoside rests on its isolation from Japanese green teas, the identification of kaempferol as its aglycone, and its general chromatographic behaviour, which is exactly that expected when compared with the behaviour of other glycosides of kaempferol and quercetin.

Addition of quercitrin to a flavonol concentrate rendered spot KG more intense. It was also shown that quercitrin and astragalin were not separable on chromatograms run first with butanol–acetic acid–water and then with 2% acetic acid. As shown in Fig. 2 the two flavonols may be separated from one another with 80% phenol as solvent. A rather weak spot in the correct position for quercitrin has previously been reported,[1] and in view of the positive identification in Japanese teas,[4, 5, 6] it may be concluded that small quantities of quercitrin probably occur in teas from North-East India.

The rather weak spot MR, occasionally detected in teas from North-East India, but not reported by the Japanese workers, is intensified by the addition of myricitrin. Although this cannot be accepted as an unequivocal identification, the occurrence of quercitrin in tea suggests that the corresponding myricetin derivative is also likely to occur.

The remaining spots have not as yet been identified with known flavonols. Substances MG and MRG appear to be new compounds and some progress has been made in their isolation and characterization.

Substance MG

Dried green tea leaf (150 g.) was powdered and extracted in the cold with successive portions of methanol until the extracts were almost colourless. The combined extracts were concentrated *in vacuo* until a trial portion was found to give a satisfactory precipitate with chloroform. The concentrate was poured, with stirring, into four volumes of chloroform and the precipitate washed with chloroform and light petroleum. The product was dried, redissolved in methanol and again precipitated by chloroform, washed as before, and dried in a vacuum desiccator over paraffin wax (yield 37 g.). This material was dissolved in water (250 c.c.) and extracted continuously with ethyl acetate, which removed flavan-3-ols, monoglycosides of quercetin and kaempferol, MG and traces of rutin and kaempferol-3-rhamnoglucoside. The ethyl acetate extract was evaporated to dryness *in vacuo* (yield 15 g.).

Further fractionation was carried out in a large-scale Craig apparatus, fuller details of which will be reported later. After 100 partitions between ethyl acetate and water, chromatograms of the fractions obtained showed that the MG was still associated with (—)-*epi*gallocatechin, but most of the other components of the original mixture were well separated from it. Fractions containing MG were united, and bulked fractions (800 mg.) from three separate Craig fractionations, representing 25 g. of the original ethyl acetate extract, were dissolved in aqueous ethyl acetate, applied to a Magnesol–Celite column, and eluted with aqueous ethyl acetate, following the method of Pearl & Dickey.[15] Fractions were collected as soon as the eluate showed a positive reaction for polyphenols. The first fractions (total volume 70 c.c.) contained all the (—)-*epi*-gallocatechin and appreciable amounts of MG. Succeeding fractions (total volume 30 c.c.) contained little polyphenolic material. A broad yellow band was then washed off the column, which was shown by paper chromatograms to have MG as its main component (yield 25 mg.). The MG had therefore run as two separate bands. It is not known whether the MG is to be considered as two separate substances, or whether some of the MG was co-chromatographed with the (—)-*epi*gallocatechin.

A portion of the crude MG (10 mg.) was hydrolysed by 1N-sulphuric acid, and the resultant aglycone extracted with ethyl acetate. A small amount was dissolved in ethanol and reduced by magnesium and concentrated hydrochloric acid. The resultant blue-crimson colour was indistinguishable from the colour obtained on reduction of an authentic sample of myricetin. The colour changes observed when treated with alkali buffers at pH 10·4 and 12·0, were also the same as those observed with myricetin.[16] On treatment with an ethanolic solution of sodium ethoxide a deep blue colour was obtained ; the same colour reaction is shown by myricetin.[17] The product of hydrolysis of MG is also chromatographically identical with myricetin in the Forestal solvent, butanol–acetic acid–water and 2% acetic acid, and fluoresces yellow in ultra-violet light. There can be little doubt that MG yields myricetin on acid hydrolysis.

The residual hydrolysate, after ethyl acetate extraction, was freed from acid on a column of Deacidite and concentrated *in vacuo*, until of a suitable strength for paper chromatography. Duplicate paper chromatograms were run in butanol–acetic acid–water and sprayed with *p*-anisidine hydrochloride and with aniline phthalate. The chromatograms indicated the presence of one sugar only, identical in R_F value and colour reactions with glucose. The concentrate yielded a crystalline osazone on treatment with phenylhydrazine. The time for separation of the crystals was six minutes ; a solution of glucose yielded an osazone precipitate in the same time.

Examination of the products of acid hydrolysis therefore leads to the conclusion that MG is a glucoside of myricetin. The R_F values in butanol–acetic acid–water and in 2% acetic acid are those expected for a monoglucoside. MG has a lower partition coefficient in ethyl acetate–water than *iso*quercitrin and one that is higher than those of kaempferol-3-rhamnoglucoside and rutin, judging by separations effected in a Craig distribution. This again indicates MG to be monoglycosidic. The yellowish-brown spot observed on chromatograms in ultra-violet light shows the 3-hydroxyl group of myricetin to be substituted. It may therefore be provisionally concluded that MG is myricetin-3-glucoside.

Measurements of the absorption spectrum of crude MG (by Miss D. M. Williams) also support this identification. In ethanolic solution crude MG showed a well-defined maximum at 366 mμ, displaced to 420 mμ in the presence of 0·1% aluminium chloride. The corresponding figures, obtained by Swain,[17] for quercetin, myricetin and their monoglycosides, show that MG bears a relationship to myricetin and myricitrin very similar to that shown by *iso*quercitrin to quercetin and quercitrin (see Table I).

Table I

Absorption spectra of myricetin etc.

Flavonol	$\lambda_{max.}$	$\lambda_{max.}$ (+ added $AlCl_3$)
Quercetin	375 mμ	430 mμ
*iso*Quercitrin	362	410
Quercitrin	350	410
Myricetin	378	450
MG	366	420
Myricitrin	353	423

Substance MRG

The best source of MRG was the Indo-China concentrate used in investigations of the leucoanthocyanins in tea.[18] A solution of this concentrate in methanol was applied as a narrow band along the starting line of a sheet of Whatman 3MM paper and the mixture separated by development with butanol–acetic acid–water. The MRG band was located by ultra-violet light, cut out, and the MRG extracted with 50% aqueous ethanol. The extract was concentrated *in vacuo*, and hydrolysed with 1N-sulphuric acid for several minutes. The resultant aglycone was extracted with ethyl acetate and shown chromatographically to be identical with myricetin. The residual aqueous layer was freed from acid on a column of Deacidite, and the eluate concentrated. Using the same method as used for the hydrolysate of MG it was shown that the hydrolysate of MRG contained glucose and rhamnose in approximately equal proportions.

MRG shows up as a yellowish-brown spot on chromatograms when viewed by ultra-violet light, so that it is presumably a 3-glycoside. MRG may therefore be provisionally identified as

myricetin-3-rhamnoglucoside. The relative positions in Fig. 1 of myricetin, quercetin, MRG and rutin are in accordance with this identification, but more rigorous proof is desirable.

Two-way chromatograms with 80% phenol and butanol–acetic acid–water as solvents

Only two of the flavonols, rutin and quercitrin, were identified on the original map of flavonol spots presented by Roberts & Wood,[1] where phenol saturated with water and butanol–acetic acid–water were the solvents employed. It is now possible to construct a map using known flavonols; such a map is illustrated in Fig. 2.

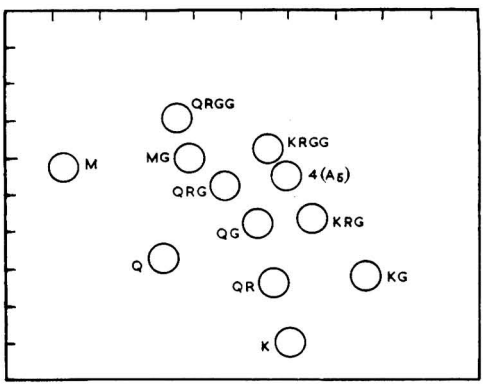

FIG. 2.—*Paper chromatogram of flavonols occurring in tea*

The paper was run first from left to right with 80% aqueous phenol and then downwards with butanol–acetic acid–water. Key to spots as in Fig. 1

Comparing this with the earlier map the following identifications are made: A1 = quercetin-3-rhamnodiglucoside, A2 = kaempferol-3-rhamnodiglucoside, A3 = myricetin-3-glucoside, A4 = rutin, A9 = *iso*quercitrin, A10 = kaempferol-3-rhamnoglucoside, A11 = quercitrin and A12 = astragalin. Judging by the R_F value in butanol–acetic acid–water A5 is to be identified with the unknown spot 4 in Fig. 1. As previously shown A6, A7 and A8 belong to the chlorogenic acid group.[19]

These results are not in good agreement with those obtained by Oshima & Nakabayashi.[4] The discrepancies are mostly in the R_F values obtained with phenol; the Japanese values are consistently lower than ours and there is less separation between the quercetin and kaempferol series in their chromatograms than ours. This latter effect leads to quite a different pattern of spots. It is known that adsorption by filter paper is an important factor determining R_F values of flavonols,[20] and it is possible that these differences are associated with variations in the nature of the filter paper. It is of interest to record that with Whatman No. 1 paper the same general pattern of flavonol spots has been obtained over a period of more than five years in both of our laboratories.

The occurrence of individual flavonols in teas

It is not usually possible to detect myricetin, quercetin or kaempferol in the reconstituted juice of dried green leaf obtained from the Plains of North-East India, nor in ethyl acetate extracts of manufactured teas from these districts. If these ethyl acetate extracts are partitioned between ether and water in a Craig apparatus, the leading tubes are found to contain all three aglycones. The aglycones, therefore, are detectable only after concentration. On the other hand quercetin and kaempferol have been detected in the ethyl acetate extracts of manufactured teas from Darjeeling, China, Japan, Formosa and Iran without any preliminary concentration.

In manufactured teas from North-East India, and in comparable samples of dried green leaf, five flavonols predominate; these are myricetin-3-glucoside, *iso*quercitrin, astragalin, rutin and kaempferol-3-rhamnoglucoside. The 3-rhamnodiglucosides of quercetin and kaempferol can be

detected in concentrates but are present in much smaller amounts than the five mentioned above. The other flavonols are also found from time to time, usually in trace amounts. The detection of myricetin-3-rhamnoglucoside is complicated by the overlapping of its spot with that of (−)*epi*gallocatechin and it is possible that its occurrence is rather more general than has hitherto appeared.

In an earlier communication[1] it was stated that the flavonols A1 and A2 (i.e., the rhamnodiglucosides of quercetin and kaempferol) were only found in tea-plants of a China type. In extension of this claim it can now be stated that these flavonols are only found in quantity in leaf taken from tea-plants considered by Dr. Wight to possess certain China attributes, defined by a slight mattness (absence of gloss) of the upper surface of the leaf. This statement is based on the results of examination of a wide variety of single bushes and clones under cultivation at the Tocklai Experimental Station. Broadly speaking, plants with these attributes are atypical in the plains of North-East India and the manufactured teas have a low content of these flavonols. In the Darjeeling district there is a much higher proportion of matt-leaved plants, and mattness is also characteristic of the tea grown in China, Japan and Formosa. Examination of commercial black and green teas from these sources has shown one or other or both of the rhamnodiglucosides to be the most abundantly occurring of the flavonol glycosides. In these same sources the proportion of myricetin glycosides is often low. Seven representative samples of dried green leaf, and of the teas manufactured from them, were obtained from the Makurazaki Black Tea Experimental Station, and examined for flavonols. Here again the rhamnodiglucosides were the predominant flavonols in five of the samples ; the other two, significantly enough, were raised from seed obtained from North-East India.

Although Japanese workers have neither isolated nor detected myricetin or its glycosides in green teas,[4, 5, 6] we have detected myricetin-3-glucoside in all ten of the Japanese teas investigated, and in two cases have also found myricetin-3-rhamnoglucoside. On the other hand we have been unable to detect either quercetin-3-triglucoside or kaempferol-3-triglucoside,[4, 5, 6] in any of the teas investigated, including those from Japan. The reasons for these discrepancies are not yet apparent.

Effect of flavonols on tea-fermentation

Rates of oxygen uptake were measured in a Warburg respirometer of a fine mince of tea-leaf (150 mg.) suspended in water (3 c.c.),[21] and the effects of addition of flavonols (5 mg.) on this system determined. The uptakes recorded are shown in Table II.

Table II

Effect of added flavonols on rate of uptake of oxygen by minced tea-leaf suspension

Time, min.	Control	With myricitrin (5 mg.) added	With quercetin (5 mg.) added
	Oxygen uptake, μl.		
10	79	78	79
20	132	132	135
30	147	148	149
60	165	166	171
120	182	184	190
	Control	With quercitrin (5 mg.) added	With rutin (5 mg.) added
15	173	175	170
30	257	255	249
60	294	294	282
120	319	324	312

The additions of the flavonols were without significant effect upon the initial rate of oxygen uptake and the total uptake. The flavonols therefore cannot have been oxidized to any appreciable extent following their addition to the fermenting tea-leaf.

Discussion

The R_F values of flavonoid aglycones in water

Zero R_F values in water for quercetin and myricetin were first observed by Roberts & Wood,[22] and more extensive studies by Geissman[11] have shown that other flavonol aglycones, cyanidin and the aglycones of flavones, aurones and chalcones have R_F values at or near zero in water. Our own unpublished observations add delphinidin and ellagic acid to this list. Related substances with R_F values greater than zero include the flavan-3-ols,[2, 22] the leucoanthocyanins,[12, 18, 23] flavanolones,[11, 12] flavanones[11] and dihydroaureusidin.[11] Consideration of the structures of these substances leads to the conclusion that they have zero R_F only when both hydroxylated benzene rings are in the same plane. This possibility has already been considered by Roux[12] and it is now submitted that the weight of evidence in favour of this view is too great for it to be due merely to coincidence.

The association of planar structure with zero R_F in water is of some value in determining the nature of a flavonoid, and was one of the supporting lines of reasoning which led to the identification of the anthoxanthins of tea as flavonols.

Correlation between structure and chromatographic behaviour

The positions on a two-way chromatogram of the glycosides of kaempferol, quercetin and myricetin are determined by the R_F values in butanol–acetic acid–water and in 2% acetic acid. These, in turn, depend upon the number of phenolic hydroxyl groups and upon the extent of glycosidation. In butanol–acetic acid–water it was shown by Bate-Smith & Westall[24] that the R_F decreased progressively with an increase in the number of phenolic hydroxyl groups. It was also claimed that glucosidation had an approximately constant effect upon the R_M. This constancy requires the R_F of the aglycone to be considerably greater than that of glucose. The R_F of myricetin is not much greater than that of glucose, so that the effect of glucosidation is much less than in the cases of quercetin and kaempferol.

With water or 2% acetic acid as solvent it would be anticipated that the increased water solubility which usually results from a higher hydroxylation would be associated with a higher R_F. Somewhat surprisingly the reverse is the case when the catechins and gallocatechins are compared (see Table III).

Table III

R_F values in water of catechins and gallocatechins

(−)-*epi*catechin gallate	0·31	(−)-*epi*gallocatechin gallate	0·26
(−)-*epi*catechin	0·33	(−)-*epi*gallocatechin	0·27
(+)-catechin	0·44	(+)-gallocatechin	0·37

This appears to be quite a general effect and in Table IV are given the R_F values in water or 2% acetic acid of a wide variety of simpler phenolic substances. Values marked with an asterisk are those quoted by Geissman,[11] the remainder are our own figures. It will be seen that in all cases the introduction of an extra hydroxyl group in the benzene ring has resulted in a small but significant decrease in the R_F.

The effect of glycosidation, as anticipated, is to increase the R_F. Higher degrees of glycosidation result in correspondingly higher R_F values. These conclusions are drawn from a consideration of values for 3-glycosides only, and do not necessarily apply when glycosidation is in other positions, as exemplified by the very low R_F values recorded by Geissman for 7-glycosides such as quercimeritrin and aureusin.[11]

The combined effects of the number of phenolic hydroxyl groups and extent of glycosidation are illustrated in Table V showing R_F values in 2% acetic acid of the more important flavonol glycosides occurring in tea.

If the effects of the number of phenolic hydroxyl groups and of glycosidation on the R_F in butanol–acetic acid–water are also considered it will be seen that a mixture of the glycosides of these flavonols will be resolved into quite a simple pattern of spots on a two-way chromatogram

Table IV

R values in water or 2% acetic acid

Substance	Number of OH groups	R_F
Resorcinol	2	0·72
Phloroglucinol	3	0·60
Catechol	2	0·72
Pyrogallol	3	0·68
p-Hydroxybenzaldehyde	1	0·75*
3 : 4-Dihydroxybenzaldehyde	2	0·67*
2 : 4-Dihydroxybenzaldehyde	2	0·66*
Resacetophenone	2	0·65*
Phloracetophenone	3	0·44*
p-Hydroxybenzoic acid	1	0·57
Protocatechuic acid	2	0·50
Gallic acid	3	0·44
p-Coumaric acid	1	0·40
Caffeic acid	2	0·25
Phenylalanine	0	0·84
Tyrosine	1	0·76 (streaking)
3 : 4-Dihydroxyphenylalanine	2	0·70

* Values given by Geissman[11]

Table V

R_F values of flavonol glycosides in 2% acetic acid

Glycoside	Aglycone		
	Kaempferol	Quercetin	Myricetin
3-Glucoside	0·19	0·14	0·06
3-Rhamnoglucoside	0·33	0·29	0·22
3-Rhamnodiglucoside	0·63	0·53	(0·34)*

* This identification of spot 3 is unconfirmed

as can be seen in Fig. 1. The regularity of this pattern is indicative of regular differences in the molecular formulae of these substances, and may be taken as affording some confirmation of the identities proposed for the previously unrecognized or uncharacterized flavonols of tea revealed on the paper chromatograms. The position taken up by a flavonol on such a paper chromatogram can therefore be taken as a useful indication of the nature of its aglycone and of the extent of glycosidation, although it gives no precise information as to the structure of the glycosidic moiety.

Stability of flavonols to oxidation during fermentation

Although it has previously been shown that flavonol glycosides are not oxidized in the presence of the tea oxidase,[3] it has been established that myricitrin is oxidized if (+)-catechin is also present. This suggested that oxidation of the glycosides of myricetin might take place during fermentation.

Experiments in which flavonol glycosides are incubated with finely minced tea-leaf without significant effect upon the oxygen uptake show such indirect oxidation of the flavonols to be unlikely. The failure of the myricetin glycosides to be oxidized under these conditions is probably due to the comparatively low oxidation–reduction potential of the gallocatechins, as compared with that of (+)-catechin, and to the presence of other substances in the system oxidizable by the *o*-quinone of (+)-catechin. Despite the undoubted ability of myricetin glycosides to be oxidized by *o*-quinones there is no evidence to suggest that this takes place to any appreciable extent during fermentation.

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BITTER PRINCIPLES OF THE CUCURBITACEAE. III.*—Elaterase, an Active Enzyme for the Hydrolysis of Bitter Principle Glycosides

By P. R. ENSLIN, F. J. JOUBERT and S. REHM

An investigation has been made of elaterase, a relatively specific enzyme for the hydrolysis of bitter principle glycosides of the Cucurbitaceae. A comparative study covering 33 different species showed that this enzyme is widely spread in this family. Elaterase was isolated from the fruit juice of *Ecballium elaterium*, *Cucumis myriocarpus* and *Lagenaria siceraria* and was examined in the ultracentrifuge. The effects of pH, temperature, time and enzyme concentration on the rate of hydrolysis of elaterinide, the monoglucoside of elaterin, have been investigated. In addition, the action of elaterase on various other glycosides was determined.

* Part II: *J. S. Afr. chem. Inst.*, 1954, **7**, 131

Introduction

In the first paper of this series[1] the isolation and characterization of four crystalline bitter principles, the cucurbitacins A, B, C and D, were reported. These substances occur mainly in wild species of the Cucurbitaceae. The bitter principles present in the fruits of several cultivated varieties have in most cases, however, resisted all attempts at crystallization. These substances are more soluble in water than the cucurbitacins, and on paper chromatograms[2] (formamide-impregnated paper) hardly migrate from the starting line. The high polarity of these substances led us to suspect that they were glycosides.

The occurrence of bitter principle glycosides in this family has been reported previously for *Ecballium elaterium*, *Citrullus colocynthis* and *Bryonia* species. Berg[3] isolated elaterinide, the monoglucoside of elaterin, from *Ecballium elaterium*, in the amorphous state, admixed with other closely related glycosides. The isolation of glycosides from *Citrullus colocynthis* has been reported several times.[4] Although some of the substances that have been isolated were claimed to be crystalline, they are generally badly characterized and might have been mixtures of many substances. Power & Moore[5] found only small quantities of glycosidic material in *Citrullus colocynthis* and isolated elaterin in good yield on one occasion only. Recent attempts to isolate elaterin from *Citrullus colocynthis* have been unsuccessful.[6] The hydrolysis of these glycosides with dilute acid led to amorphous products in which the aglycone part of the glycoside underwent secondary changes.[3] Berg[7, 8] found that in the expressed juice of fruits of *Ecballium elaterium* the glycoside elaterinide is rapidly hydrolysed by an enzyme, named elaterase, with precipitation of the insoluble aglycone, elaterin, but he failed to isolate this glycosidase. Power & Moore[9] queried Berg's work on the ground that elaterin could be isolated from the fruits of this plant under conditions which prevented any enzymic hydrolysis. Oppenheimer[10] questioned the existence of elaterase as a specific enzyme.

In this paper the occurrence in the Cucurbitaceae of elaterase, a glycosidase which rapidly hydrolyses bitter principle glycosides, and a method for the isolation and characterization of this enzyme, are described. The activity and relative specificity of elaterase have been investigated.

Results

Paper chromatography[2] of the bitter principles of *Ecballium elaterium* demonstrated that free elaterin, elaterinide, and the glycosides of three other bitter principles occur naturally in the fruits. The presence of an enzyme capable of hydrolysing these glycosides was shown by chromatography of the bitter substances isolated before and after autolysis (see below). When this experiment was repeated on the fruit juice of certain *Cucurbita* and *Citrullus* species, no hydrolysis of the glycosides present in these extracts was found. It was, however, possible to hydrolyse these glycosides very rapidly by adding the fruit juice of *Ecballium elaterium* or of certain other species of the Cucurbitaceae. A systematic survey of the occurrence of glycosidases in a large number of cucurbits was therefore undertaken.

Elaterinide, which can be isolated free of other bitter substances from *Cucurbita texana*, *Citrullus colocynthis*, *Citrullus ecirrhosus* and *Citrullus vulgaris*, proved to be an ideal substrate for a comparative study of the glucosidase activity of different plants. After purification (see below) elaterinide was obtained as a light yellow amorphous powder which, on total enzymic hydrolysis, gave 97% of the theoretical yield of elaterin, m.p. 230–231°, in addition to D-glucose. Pure elaterin melts at 234·5°. Elaterinide is thus the monoglucoside of elaterin and our preparation had a purity of at least 90%. On a paper chromatogram the purified elaterinide gave only one spot, further indicating its relative purity.

The extent of hydrolysis of elaterinide can be calculated from the weight of crystalline elaterin which, as a result of its low solubility in water (0·012%), crystallizes out rapidly and almost quantitatively after it is formed.

The elaterase activity of the fruit juices of various Cucurbitaceae

The species and varieties of cucurbits tested for elaterase activity of the fruit juice are listed in Table I. The method of extraction of fruit juice and the calculation of activities are described later.

Table I

Elaterase activity of fruit juices

Species and variety		Elaterase activity*
Acanthosicyos horrida,	young bitter and ripe non-bitter fruits	+++
Citrullus colocynthis,	bitter	—
,, *ecirrhosus,*	bitter	—
,, *naudinianus,*	non-bitter	—
,, *vulgaris,*	wild and cultivated, bitter and non-bitter varieties	—
Coccinia adoensis,	unripe, slightly bitter	+
,, *hirtella,*	unripe, bitter	—
,, *rehmanni,*	unripe, non-bitter	++
,, *sessilifolia,*	unripe, non-bitter	—
Cucumis africanus,	bitter	++
,, *dinteri,*	bitter	++++
,, *dipsaceus,*	bitter	++
,, *ficifolius,*	bitter	+++
,, *hookeri,*	bitter	+++
,, ,,	non-bitter	+
,, *humifructus,*	outer fruit flesh, bitter	++
,, ,,	fruit jelly, non-bitter	+
,, *leptodermis,*	bitter	+++
,, *melo,*	wild, non-bitter	+
,, ,,	three cultivated varieties, non-bitter	—
,, *metuliferus,*	bitter and non-bitter	—
,, *myriocarpus,*	bitter	+++
,, *prophetarum,*	bitter	+++
,, *sativus,*	var. Hanzil Medicinal, bitter	+
,, ,,	var. Early Fortune, non-bitter	—
Cucurbita maxima,	5 cultivated varieties, non-bitter	—
,, *mixta,*	bitter	—
,, *moschata,*	var. Butter Nut, non-bitter	—
,, *pepo,*	6 cultivated varieties, non-bitter	—
,, ,,	var. Ornamental Gourd, bitter	—
,, *texana,*	bitter	—
Cyclanthera pedata,	non-bitter	—
Ecballium elaterium,	bitter	+++
Echinocystis wrightii,	bitter	—
Lagenaria siceraria,	bitter	+++
,, ,,	non-bitter	—
Momordica charantia,	unripe, slightly bitter	—
Sphaerosicyos sphaericus,	bitter	+++
Trichosanthes anguina,	non-bitter	++

* See below for calculation of elaterase activity

— indicates activities <0·01
\+ indicates activities of 0·01–0·09
++ indicates activities of 0·1–0·9
+++ indicates activities of 1·0–9·0
++++ indicates activities of 10 and higher

Several genera, viz. *Acanthosicyos*, *Cucumis*, *Ecballium*, *Lagenaria* and *Sphaerosicyos*, include species with high to very high activity. Certain species of these genera occur in bitter and non- or slightly bitter forms ; in most of these cases an association of high content of bitter principle with high elaterase activity is found (*Cucumis hookeri*, *C. sativus* and *Lagenaria siceraria*). This relation between bitter principle content and enzyme activity is again found in *Cucumis humifructus* in which the fruit pulp is completely free of bitter principles and has a low enzyme activity, whereas the tough outer flesh is bitter and shows more than ten times the elaterase activity of the pulp.

The species and varieties of *Citrullus*, *Cucurbita* and *Echinocystis* tested possess no, or only very weak, elaterase activity, irrespective of bitterness.

Besides the fruits of the species listed in Table I, the ripe seeds of *Ecballium elaterium* and *Citrullus vulgaris* have been tested for enzyme activity. An aqueous extract of the finely ground seeds showed only weak elaterase activity in both cases.

Isolation of elaterase

In order to compare elaterase of different origins, crude enzymes were isolated from the

fruit juice of *Ecballium elaterium*, *Cucumis myriocarpus* and *Lagenaria siceraria* by precipitation with ethanol (see below). Yields of 0·07, 0·31 and 0·24%, respectively, were obtained. The amount of crude enzyme required to give 50% hydrolysis of 100 mg. of elaterinide in 45 minutes was 0·58, 0·24 and 0·12 mg. from the three fruits, respectively.

All three crude enzyme preparations gave optimum hydrolysis of elaterinide within the same pH range, i.e., 4·0 to 5·5 in phosphate buffer. The difference in activity of the three preparations is probably due to differences in purity, which were also evident from their sedimentation diagrams.

Crude elaterase (0·3 g.) was dissolved in 10 ml. of 0·06M-phosphate buffer, pH 6·6 and dialysed overnight. The dialysed solutions were then examined in a Spinco electrically driven ultracentrifuge at a speed of ~57,000 r.p.m. For *Cucumis myriocarpus* elaterase a single component of a sedimentation constant of 4·1 Svedberg units (S.U.) was found. The slight asymmetric shape of the peak, however, indicated the presence of some slowly sedimenting material. The sedimentation diagram of *Ecballium elaterium* elaterase revealed only one peak of 3·4 S.U. Considerable peak spreading with time of centrifugation was noticed. This probably arises from the heterogeneous nature of this component. In the case of *Lagenaria siceraria* elaterase two sedimenting components of 4·3 and 0·9 S.U. were noticed (see Fig. 1).

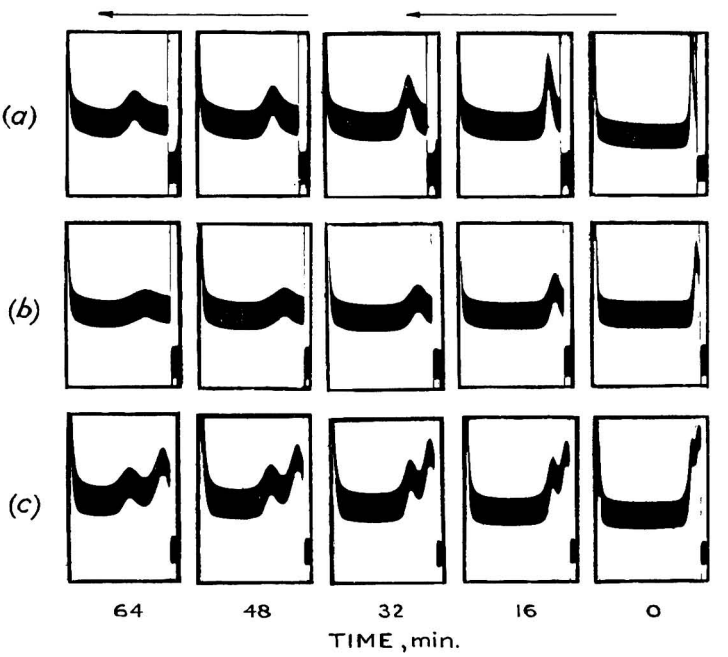

FIG. 1.—*Sedimentation diagrams of crude elaterase isolated from fruit juice of* (a) Cucumis myriocarpus, (b) Ecballium elaterium, (c) Lagenaria siceraria

Whereas appreciable quantities of the slow component (0·9 S.U.) appeared with *Lagenaria siceraria* elaterase, such a component was not significant in the elaterase preparation from *Cucumis myriocarpus*. However, the products from both *Lagenaria siceraria* and *Cucumis myriocarpus* contained a component with a sedimentation constant of approx. 4·2 S.U. It would therefore appear that the activity of the enzyme is associated with the 4·2-S.U. component. The lower value found for *Ecballium elaterium* elaterase (3·4 S.U.) is explainable by the heterogeneous nature of this preparation.

For the preparation of large quantities of elaterase the fruit juice of *C. myriocarpus*, which had a high enzyme activity and was available in large quantities, was employed.

In an attempt to fractionate the crude enzyme, various amounts of ammonium sulphate were added to a 0·5% solution of elaterase in 0·1M-acetate buffer of pH 5·0. Since the activities of the fractions obtained at 50, 65 and 90% saturation with ammonium sulphate were the same, no fractionation of the enzyme had occurred. Dialysis of crude elaterase gave no appreciable purification.

Characterization of crude elaterase

The hydrolysis of elaterinide by crude elaterase showed a temperature optimum of 50° in experiments of 40-min. duration. Above this temperature the enzyme is rapidly destroyed.

Up to the stage where about 90% of the elaterinide is split, the degree of hydrolysis is an approximately linear function of the enzyme concentration. In an experiment in which the extent of hydrolysis with time was investigated, an initial lag was found which is partly due to the solubility of elaterin in a 4% aqueous alcoholic solution (0·012% at 37°) but mainly to a lag in the crystallization of the elaterin formed. Seeding of solutions with crystalline elaterin gave some improvement.

Specificity of the enzyme

In order to establish the relative specificity of elaterase for elaterinide and other bitter principle glycosides, its action on a number of other well-known glycosides was investigated. The results of these experiments are summarized in Table II.

Table II

Relative specificity of elaterase

Substrate	Amount of substrate, mg.	Amount of enzyme, mg.	Time, hours	% hydrolysis
Maltose	100	50	2	0
Sucrose	100	50	2	2
Arbutin	100	50	1	7
Salicin	100	50	1	7
Phloridzin	100	53	2	9
Aesculin	100	12	1	56
Digitonin	100	52	2	0
Scilliroside	20	20	2	14
Scillaren A	20	20	2	3
k-Strophanthin-β	20	20	2	18
Digilanide A	20	20	2	49
Elaterinide	100	0·2	1	73
Cucurbitacin B glycoside	90	0·2	1	70

The extent of hydrolysis of scilliroside, scillaren A, *k*-strophanthin-β and digilanide A was calculated from a determination of glucose, the only sugar produced, on paper chromatograms. Full details of these experiments have been published elsewhere.[11] In the case of elaterinide the weight of elaterin produced was used for calculation. The extent of hydrolysis of cucurbitacin B glycoside was determined on paper chromatograms by comparing the size and intensities of cucurbitacin B spots produced with those obtained from known amounts of cucurbitacin B. In the case of all the other glycosides the extent of hydrolysis was calculated from the increase in reducing power of the solutions (sugar titrations according to Lehmann-Maquenne[12]).

Elaterase is capable of hydrolysing a variety of β-glycosides whereas the α-glycoside, maltose, is not attacked. The specificity of elaterase for β-glycosides is further illustrated by the hydrolysis of the four cardiac glycosides which proceed with the loss of only a molecule of glucose.[11] Although elaterase hydrolysed glycosides such as aesculin and digilanide A at a fair rate, the hydrolysis of elaterinide and cucurbitacin B glycoside was nearly 100 times faster.

The hydrolysis of other bitter principle glycosides, which usually occur in complicated mixtures (e.g., in varieties of *Cucurbita pepo* and *Ecballium elaterium*), was followed on paper chromatograms and was found to proceed at rates comparable to that for elaterinide.

Elaterinide is very slowly hydrolysed by other β-glycosidases. Fourteen mg. of emulsin

(Merck) hydrolysed 100 mg. elaterinide to an extent of 5% in two hours, and 31 mg. of a glycosidase isolated[13] from the common garden snail, *Helix aspersa*, hydrolysed 200 mg. elaterinide to an extent of 14% in ten hours.

It is therefore clear that elaterase is a relatively specific glycosidase for the hydrolysis of bitter principle glycosides of the Cucurbitaceae. The question arises whether ' elaterase ' is the best name for this enzyme since it is not specifically associated with elaterinide. Until more is known about the structure of the bitter principle glycosides and their hydrolysis, it is proposed to retain the name elaterase which was given by Berg[7] for the enzyme associated with elaterinide in the fruit juice of *Ecballium elaterium*. Crude elaterase preparations from *Cucumis myriocarpus* and *Lagenaria siceraria* are most probably identical with elaterase from *Ecballium elaterium*, differing only in purity.

Experimental

Enzymic hydrolysis of glycosides, followed on paper chromatograms

Full details of the paper chromatography of bitter principles have been described previously.[2] Bitter principles were separated on Whatman No. 540 paper impregnated with formamide, ethyl acetate–benzene (3 : 2) being the moving phase. Spots were made visible by spraying with a 0·5% solution of potassium permanganate in a saturated, aqueous solution of copper acetate. After heating in an oven at 100° for three minutes, blue spots appeared against a brown-green background. A 0·5M-aqueous solution of ferric chloride proved to be another very sensitive spray reagent. Elaterin immediately forms an intense mauve spot ; cucurbitacins B and D formed mauve spots only after heating in an oven at 100° for three minutes. Cucurbitacins A and C and the glycosidic bitter principles give no reaction. All compounds produce coloured spots with the potassium permanganate–copper acetate spray.

Freshly full-grown fruits of *Ecballium elaterium* (50 g.) were macerated to a fine pulp in a Waring Blendor together with 96% alcohol (50 ml.) and a saturated solution of basic lead acetate (50 ml.). The enzymes present were thus precipitated as soon as they were liberated. After filtration through folded filter paper the bitter principles were extracted with chloroform. Evaporation of the chloroform extract gave a white foam which separated on paper into a glycoside spot on the starting line and a faint spot of elaterin at R_F 0·82. Enzymic hydrolysis of this product with elaterase gave a product which no longer produced a glycoside spot on the starting line, but gave a strong elaterin spot at R_F 0·82 and three other strong spots at R_F 0·54, 0·65 and 0·75.

This experiment was repeated with bitter principles isolated from many species and varieties of the Cucurbitaceae. In some cases as many as seven bitter-principle-spots appeared on chromatograms after hydrolysis of the original glycosides.

Purification of elaterinide

Crude elaterinide was isolated according to the method described in Part I of this series.[1] Yield : from *Cucurbita texana* 0·1%, from *Citrullus vulgaris* 0·03%, from *Citrullus colocynthis* 0·3%. The treatment of crude elaterinide (140 g.) dissolved in 96% ethanol (1000 ml.) with animal charcoal gave a light yellow solution. Benzene extraction of the solution after dilution with water (400 ml.) removed fatty and coloured impurities. The elaterinide solution was then diluted with a further 1400 ml. of water, a few g. of sodium chloride were added to facilitate separation of layers and five extractions with chloroform were carried out. After washing the chloroform extract with water and evaporation *in vacuo*, a white foam was obtained. Finally the product was dissolved in acetone (750 ml.) and precipitated into pentane (4000 ml.). The precipitate was washed with pentane and dried *in vacuo*. Yield : 120 g. of a white powder, $[\alpha]_D^{19}$ — 70° (*c*, 0·574 in chloroform), $\lambda_{max.}$ 235 mμ (log ε 4·07). For analysis, the product was dried for 12 hours at 70° and 10^{-4} mm. (Found : C, 61·6, 61·7 ; H, 7·9, 7·6%. $C_{34}H_{48}O_{12}$ requires C, 63·0 ; H, 7·7%. $C_{34}H_{50}O_{12}$ requires C, 62·8 ; H, 7·8%). All attempts to purify the amorphous elaterinide by crystallization failed. However, when chromatographed on Whatman No. 540 filter paper impregnated with the upper phase of an equilibrated mixture of *n*-octanol, fermentation amyl alcohol, water and formamide (8 : 2 : 8 : 2) and developed for 21 hours at 30° with the lower phase,[14] the purified elaterinide formed a single well-defined spot at R_F 0·57.

Cucurbitacin B glycoside, isolated from *Cucurbita mixta* and purified according to the above procedure, gave a white powder which still contained a very small amount of free cucurbitacin B.

Identification of the products formed by the enzymic hydrolysis of elaterinide

Elaterinide (761 mg.) was dissolved in 96% ethanol (4 ml.) and water (86 ml.) quickly added. To the almost clear solution was added a solution of elaterase (5·5 mg.) dissolved in water (10 ml.). The solution became turbid almost immediately and after a few minutes crystals separated out. To ensure complete hydrolysis the solution was kept for 16 hours at 30°. The crystals were then collected quantitatively on a sintered glass Gooch crucible and washed well with water. Yield of oven-dried product: 550·8 mg. (96·8% of the theoretical yield of elaterin from its monoglucoside), m.p. 230–231°. After recrystallization from chloroform–ethanol the m.p. rose to 234·5°, $[\alpha]_D^{19}$ — 62·2° (*c*, 0·572 in chloroform). For analysis the product was dried for 3 hours at 100° and 10^{-4} mm. (Found: C, 68·9, 68·6, 69·0; H, 8·3, 7·9, 8·0%. $C_{28}H_{38}O_7$ requires C, 69·1; H, 7·9%. $C_{28}H_{40}O_7$ requires C, 68·8; H, 8·3%). This product gave an ultra-violet absorption spectrum ($\lambda_{max.}$ 233 mμ, log ε 4·08; 268 mμ, log ε 3·89 in 96% ethanol) and infra-red absorption spectrum identical with authentic elaterin isolated from elaterium obtained from S. B. Penick & Co., N.Y.

The aqueous extract, left after filtering off the crude elaterin, was then extracted three times with chloroform to remove traces of dissolved elaterin. Evaporation of the aqueous solution in a vacuum gave a syrup (233 mg.) which, when spotted on Whatman No. 1 filter paper, developed with butanol: ethanol: water, 20 : 1 : 3 mixture, and sprayed with a 3% solution of *p*-anisidine hydrochloride in water-saturated butanol,[15] gave only one spot which appeared at the same R_F value as glucose. The syrup was then dissolved in water (0·1 ml.) acetic acid (0·5 ml.) was added and the solution seeded with D-glucose. After keeping in a cold room overnight, crystals (64 mg.) of m.p. 137–138° separated out. On recrystallization from water (0·1 ml.) and acetic acid (0·6 ml.), white crystals (21 mg.) were obtained, m.p. 143–144°. Mixed m.p. with D-glucose of m.p. 148–150° was 145–148°, $[\alpha]_D^{18}$ + 52·2° (equilibrium value, *c*, 1·116 in water).

Estimation of elaterase activity

Fresh fruits were minced and the juice squeezed through cheese cloth. On keeping under toluene overnight at room temperature, the viscous juice had clarified by the formation of a voluminous precipitate which was filtered off on Whatman No. 12 folded filter paper. Varying amounts of the clear filtrate were added to a solution of elaterinide prepared by adding rapidly 1 ml. of a 10% alcoholic solution of elaterinide to enough 0·05M-phosphate buffer (pH 5·0) to give a final volume of 50 ml. The solutions were kept at 37° for varying periods. The crystalline elaterin produced was collected on sintered glass Gooch crucibles, dried at 105° for 30 minutes and weighed. This weight was corrected for the amount of dissolved elaterin (solubility 0·012%).

The elaterase activity of a plant juice was calculated according to the formula:

$$\text{Elaterase activity} = \frac{\%\ \text{hydrolysis}}{100 \times \text{time (h.)} \times \text{volume (ml.)}}$$

A plant juice thus had the activity 1 when 1 ml. of the juice hydrolysed completely in 1 hour 100 mg. of elaterinide dissolved in 50 ml. of buffer solution. This formula assumes that the percentage hydrolysis is a linear function of both the enzyme concentration and the time of hydrolysis. The results in Table VII show that there is a slight initial lag in the time–hydrolysis curve, even after correcting for the amount of dissolved elaterin. This lag will affect only the lowest elaterase activity values. In all experiments where an activity >0·01 was found, the amount of juice added and the time of hydrolysis were so chosen that a percentage hydrolysis of at least 30% and not more than 80% was obtained. From the above formula it is clear that the volume of juice added, which varied between 0·01 and 5 ml., and the time of hydrolysis, which varied between ½ hour and 24 hours, are the main factors which determine the values for elaterase activity.

Solutions of isolated enzyme were prepared by making a paste of 10 mg. of elaterase with a few drops of water and then diluting to 40 ml. with buffer solution. Centrifugation at 3500 r.p.m. for 15 minutes gave a clear solution.

Isolation of crude elaterase

Unripe fruits were employed for the isolation of crude elaterase since it was observed that unripe fruits possess a higher elaterase activity than ripe ones.

To 700 ml. of autolysed and filtered juice of *Cucumis myriocarpus* successive amounts of absolute alcohol were added at 0°. Care was taken during the addition of the alcohol to ensure that the temperature never increased more than a few degrees. The precipitates obtained at alcohol concentrations of 42, 50, 56 and 73% were centrifuged off, washed with alcohol and ether and dried *in vacuo*. The weight and elaterase activity of each of these fractions are given in Table III. Elaterinide (100 mg.) was used as substrate.

Table III

Amounts and activities of fractions precipitated by alcohol of various concentrations

Alcohol concn., %	Wt. of fraction, g.	Wt. of fraction used, mg.	Time, min.	% hydrolysis
42	0·95	2	15	94
50	0·63	1	25	90
56	0·60	2	30	78
73	1·41	16	90	13

The elaterase activity was concentrated in the first three fractions. A large-scale preparation of crude elaterase was then carried out by adding absolute alcohol up to a concentration of 56% to 8200 ml. of autolysed filtered juice of *Cucumis myriocarpus*. A yield of 30 g. of the crude dry enzyme was obtained.

Dialysis of crude elaterase

Four 10-ml. samples of a 1% crude elaterase solution in water were dialysed in slowly rotating Cellophane bags against a large volume of distilled water at 4°. The concentration and activity of each sample were then determined with elaterinide (200 mg.) as substrate after different times of dialysis (Table IV). The volume of the solutions increased during dialysis.

Enzyme solutions were prepared by diluting the original solutions 1 in 25. Amounts varying from 1 to 2·45 ml. (proportional to the increase in volume during dialysis) were then added to the elaterinide solutions. The percentage hydrolysis was calculated from the amount of elaterin produced after 90 minutes of hydrolysis. The values for enzyme concentration (determined by evaporation of 1-ml. samples in an oven at 100°) were also corrected for the increase in volume during dialysis. The results are presented in Table IV.

Table IV

Dialysis of crude elaterase

Time, hours	Crude enzyme concn., mg./ml.	% hydrolysis after 2 hours
Substrate: 200 mg. elaterinide		
0	9·7	68
30	6·3	51
48	6·2	44
72	6·0	44
96	5·9	46
Substrate: 400 mg. salicin *		
0	10·7	17·2
17	6·4	18·7
38	6·1	18·6
111	5·8	18·9

* In this experiment the total undiluted enzyme solutions were added to the salicin solutions.

The total activity of the enzyme solutions decreased by 35% after 96 hours, which, when compared with the decrease of 39% in crude enzyme concentration, shows that there was no significant increase in activity of elaterase.

Contrary to this observation it was found that in a similar experiment with salicin as substrate the activity of elaterase increased by 10% whilst the concentration of the enzyme decreased by 46% after 111 hours of dialysis.

Effect of pH, temperature, time and enzyme concentration on the elaterase activity

The results are presented in Tables V to VIII. From these Tables it is seen that maximum hydrolysis with the enzyme occurs at pH 5·1–5·6 in acetate buffer or pH 4·9–5·3 in phosphate buffer. At pH 5·0 in acetate buffer the optimum temperature is 50°.

Table V

Effect of pH on elaterase activity

Elaterinide (100 mg.) and crude elaterase (0·2 mg.) in 0·1M-buffer (25 ml.) for 75 minutes

(a) *In acetate buffer*

pH	3·4	3·6	4·2	4·7	5·1	5·3	5·6	5·9	6·2	6·5	6·7
% hydrolysis	59	72	79	88	92	92	92	82	78	6·2	5·1

(b) *In phosphate buffer*

pH	4·1	4·5	4·9	5·3	5·6	5·8	6·2	6·6
% hydrolysis	62	59	65	64	59	52	40	22

Table VI

Effect of temperature on elaterase activity

Elaterinide (95 mg.) and crude elaterase (0·25 mg.) in 0·1M-acetate buffer, pH 5·0 (25 ml.) for 40 minutes

Temperature, ° C	59	50	43	36	28	19
% hydrolysis	49	83	79	53	31	10

Table VII

Extent of hydrolysis with time

Elaterinide (140 mg.) and crude elaterase (0·17 mg.) in 0·1M-acetate buffer, pH 5·0 (40 ml.)

Time, min.	15	30	45	60	75	90	105	120
% hydrolysis	6	15	36	53	61	82	91	96

Table VIII

Effect of enzyme concentration on rate of hydrolysis

Elaterinide (95 mg.) and crude elaterase in 0·1M-acetate buffer, pH 5·0 (25 ml.) for 60 min.

Elaterase, mg.	0·05	0·10	0·15	0·20	0·25
% hydrolysis	26	54	71	94	96

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STUDIES OF SPRAY DEPOSITS. II.—The Tenacity of Copper Fungicides on Artificial and Leaf Surfaces*

By E. SOMERS and W. D. E. THOMAS

Some of the factors influencing the tenacity of spray deposits of cuprous oxide, cupric oxide, copper carbonate, copper oxychloride, Bordeaux and Burgundy mixtures have been investigated. Variation in the period of drying of the initial deposits, in the intensity of washing and in the temperature (up to 45°) had little effect on tenacity on artificial surfaces. Tenacity values were found to vary with the level but not with the type of distribution of the deposit. Except for Bordeaux, the tenacities of the copper fungicides increased with decreasing initial deposit and this effect is briefly discussed in terms of the relative importance of particle–particle cohesion and particle–surface adhesion. The tenacities of cupric oxide and copper oxychloride increased with decreasing particle size, but cuprous oxide and copper carbonate did not show this effect. The fungitoxicities of different size fractions of cupric oxide, determined against *Alternaria tenuis*, did not increase with decreasing particle sizes below 6 μ, suggesting that a saturation value of the surface had been reached. The physico-chemical forces which determine the tenacity of a spray deposit, in the absence of supplements, are briefly discussed.

The relative importance of wind and rain in the weathering of deposits was determined in a field experiment. Although rain was the more important weathering agent, the effect of wind was considerable and seemed to be more prolonged.

Introduction

The tenacity† of a protective fungicide on a plant surface is determined by the physical and chemical properties of the fungicide and surface, and by the nature and type of weathering to which it is exposed. Horsfall[1] has reviewed the literature which is, however, largely devoted to the properties of commercial formulations of fungicides. These commercial materials contain surface-active compounds, of unstated amount and composition, either as deflocculating, wetting, or sticking agents and it has been established[2, 3] that such adjuvants greatly affect the tenacity of the fungicide deposit. In recent field studies with Bordeaux and zineb Rich[4] has suggested that the different tenacities of these materials are related to their different degrees of hydration in the spray suspension.

The present investigation was undertaken to establish the relative importance of some of the physico-chemical factors that influence the tenacity of fungicidal preparations in the absence of spray supplements. A small-scale field experiment was also carried out to determine the effects of wind and rain in the weathering of a spray deposit.

* Part I : *J. Sci. Fd Agric.*, 1956, **7**, 160
† Defined as the ratio of the amount of fungicide residue at a given time to its initial deposit

Experimental

Materials

Copper fungicides.—These were cuprous oxide, cupric oxide, basic copper carbonate [$CuCO_3$,$Cu(OH)_2$], copper oxychloride [$CuCl_2$,$3Cu(OH)_2$], Bordeaux* and Burgundy† mixtures. The last two compounds were prepared by adding molar copper sulphate to the diluted calcium hydroxide suspension and to the diluted sodium carbonate, respectively. The samples of the copper oxides, copper carbonate and oxychloride, shown by copper analysis to be over 96% pure, were passed through a B.S.S. sieve no. 200; microscopical examination showed that the particles were angular and approximately spherical in shape. Fig. 1 gives their effective particle-size distribution as determined by duplicate sedimentation analyses with an Andreasen pipette at 25·0 ± 0·1°. Fractional sedimentation was used to separate the fungicides into uniform particle size ranges, and for these suspensions the particle diameters were measured with a microscope using a Fairs[5] graticule. At least 500 particles were measured for each suspension.

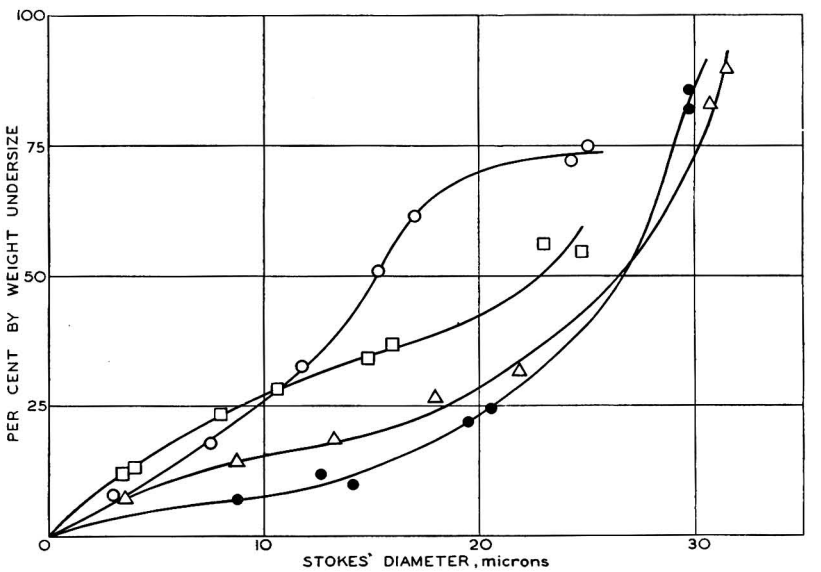

FIG. 1.—*Particle size distribution curves*

○ Cuprous oxide
□ Cupric oxide
△ Copper oxychloride
● Copper carbonate

Artificial surfaces.—Reproducible surfaces were prepared by dipping 7·6 × 2·5 cm. glass slides into one of the following solutions: cellulose acetate,[3] cellulose nitrate (2·5% in butyl acetate), and a commercial polybutyl methacrylate resin. The slides were drained and dried at 80° for 18 h. Slides were also dipped into paraffin wax (m.p. 54–57°) at 100° and removed after the wax separating on the slide had melted.

Leaf surfaces.—All experiments were carried out with the upper surfaces of detached leaves except where otherwise stated. Preliminary experiments had established that the tenacity of deposits on newly detached leaves did not differ from the tenacity of similar deposits which had dried on the plant. The leaves of 2–3-month-old cauliflower (var. Majestic), tomato (var. Market King), potato (var. King Edward), and 3–4 week-old broad bean (var. Giant Windsor), raised in a cold glasshouse, were sprayed immediately after cutting.

* $CuSO_4,5H_2O$ 10 lb., $Ca(OH)_2$ 12·5 lb., water 100 gal.
† $CuSO_4,5H_2O$ 10 lb., $Na_2CO_3 10H_2O$ 11·4 lb., water 100 gal.

Methods

Determination of the tenacity of spray deposits.—The procedure followed has been previously described.[3] Aqueous suspensions of the copper fungicides (at 0·05–1·00% Cu) were sprayed, to below ' run-off ', on to slides or leaves placed on the spray wheel. The deposits were dried at 25° for varying intervals (24 h. for slides, 18 h. for cauliflower, 6 h. for tomato and potato and 3 h. for bean leaves). One-third of the spray deposits were analysed as initial deposits whilst the rest were sprayed with water in the standard wash apparatus (' rainfall ' of 2·3 cm./min.), generally for 10 or 60 sec. The initial deposits and residues were analysed for copper and the tenacity of the deposit calculated as $\frac{\text{weight of Cu/sq. cm. after washing}}{\text{weight of Cu/sq. cm. initial deposit}}$. All the tenacities (× 100) given below are the means of at least three determinations; variations were within ±3 on artificial surfaces and ±5 on leaf surfaces.

Bioassay of deposits.—This was effected using *Alternaria tenuis* by the technique previously described.[3]

Measurement of contact angle.—The advancing and receding contact angles of the artificial surfaces against water were determined with the tilting plate apparatus of Evans & Martin.[6] The precision of the contact angle values was within ±2°.

Adhesion number.—A modified von Buzágh[7] method was used. A 16-mm. glass culture ring, 5 mm. high, was cemented on to a cellulose acetate-coated slide, a 0·015% suspension of the fungicide pipetted into this cell and a cover slip placed on top, taking care to avoid air bubbles. The suspension was allowed to settle for 5 min. then the particles on a fixed area (defined by an eyepiece graticule) of the slide were counted (n_1) under a microscope. A glass slide was placed on top of the cell and the whole inverted. After 15 min. the number of particles (n_2) per defined area, still adhering to the base plate, was counted. The adhesion number was then $\frac{n_2}{n_1} \times 100$. At least four determinations were made for each adhesion number given; replicates agreed within ±4.

Results*

Factors influencing the tenacity of spray deposits

(i) *Duration, intensity, and mode of washing.*—Similar cuprous oxide deposits (10 μg. Cu/sq. cm.) on cellulose acetate and paraffin wax surfaces were washed for periods varying from 0·5 to 60 sec. with ' normal ' rain (2·3 cm./min.) and the resultant tenacities plotted (Fig. 2). The loss of deposit was rapid only for the first 2 sec. Similar deposits on cellulose acetate were treated with washes of greater intensity (4·9 and 14·1 cm./min.) by moving the slide holder in the wash apparatus nearer to the spray nozzle. Fig. 2 shows that only very slight further loss of deposit occurred when the intensity was increased from 2·3 to 14·1 cm./min., and that there was no difference between the tenacities of deposits exposed to 2·3 and 4·9 cm./min. ' rainfall ' (no separate plot for the latter is given in Fig. 2).

To investigate the effect of variation of the mode of washing of a deposit which may alter chemically on ageing, similar Burgundy deposits on cellulose acetate were subjected to a 30-sec. wash given in 1, 3 or 6 applications, the times of each individual wash being 30, 10 and 5 sec., respectively. The deposits were dried at 25° for 24 h. between each wash. The results (Table I) show that a single wash was as effective as a number of washes having the same total volume in removing the deposit and also that drying the deposit between washes did not affect its tenacity.

(ii) *Duration and temperature of drying.*—The effect of prolonging the interval between spraying cuprous oxide (on bean leaf and cellulose acetate) and washing the deposit beyond the standard drying times was determined. For the bean leaves the upper surfaces of the leaves of five plants were hand-sprayed, using a spray gun, with cuprous oxide (at 0·25% Cu) to beyond ' run-off '. One leaf per plant was taken for the initial deposits (when dry) and at each sampling

* In general the fungicide suspensions, at 0·25% Cu, were sprayed to give initial deposits in the range 10–25 μg. Cu/sq. cm. Where different deposit levels were required, the suspensions were diluted accordingly.

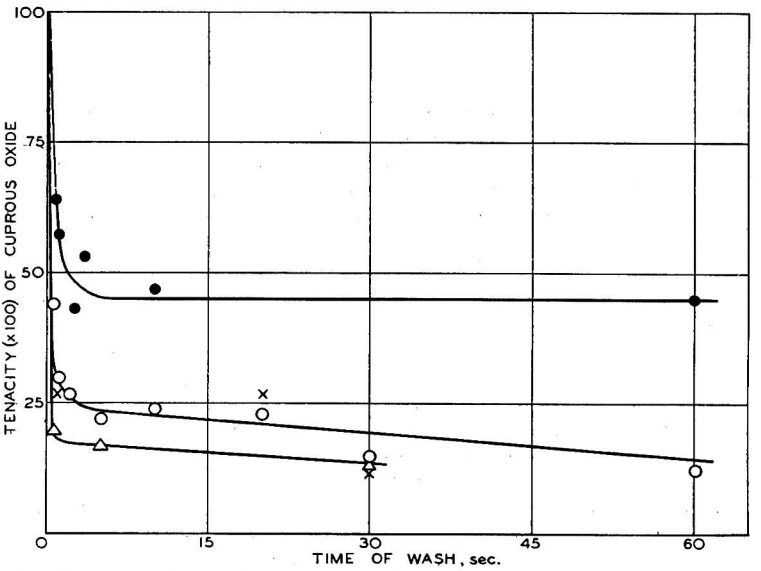

FIG. 2.—*Tenacity of cuprous oxide on cellulose acetate and paraffin wax, with varying time and intensity of wash*

Surface	Intensity of 'rainfall' (cm./min.)
● Paraffin wax	2·3
○ Cellulose acetate	2·3
× ,, ,,	4·9
△ ,, ,,	14·1

Table I

Variation of the tenacity of Burgundy, on cellulose acetate, with the application of a total 30-sec. wash as a series of 5- or 10-sec. washes

Initial deposit = 10 μg. Cu/sq. cm.

Number of washes	Time of wash, sec.	Tenacity (× 100)
1	30	83
3	10	87
6	5	79

date, and the plants were kept at room temperature (12–18°) for intervals up to 144 h. Cuprous oxide deposits on cellulose acetate were dried at the standard temperature of 25°. The variation of the tenacities on the hand-sprayed leaves was greater than that on cellulose acetate and the limits of the means of the former are given as ±2 S.E. in Table II. The results show no difference (significant at the 5% level) between the tenacities after different drying times.

Table II

Effect of prolonging the time of drying of a cuprous oxide deposit on its tenacity (× 100) *after 30-sec. wash*

Initial deposit approx. 15 μg. Cu/sq. cm.

Surface	Time of drying, h.			
	4	24	48	144
Bean leaf	51 ± 15	—	44 ± 14	44 ± 12
Cellulose acetate	—	14	17	11

When the drying temperature was increased from 25° to 45° (approximately maximum leaf temperature even under tropical conditions) it was found that there was no change in the tenacities of cuprous oxide, cupric oxide, and copper carbonate on cellulose acetate. However,

the same effect need not necessarily occur with a deposit on a flexible leaf surface under field conditions.

(iii) *Type of deposit.*—When a surface is sprayed, the discrete droplets which are formed agglomerate and eventually run-off leaving a partially or completely wetted surface. The tenacity of deposits formed after increasing intervals from the commencement of spraying was determined for bean leaf, paraffin wax and cellulose acetate surfaces. Constancy of initial deposit was ensured by suitable adjustment of the copper oxide concentration of the spray suspensions (0·12–0·75% Cu) and deposits varying from discrete spots to continuous films were obtained by using different numbers of spray wheel revolutions. The results (Table III) show that there was no difference in the tenacity of different types of copper oxide deposits formed below ' run-off ' on artificial or bean leaf surfaces. In one instance the deposit on bean sprayed to considerably beyond ' run-off ' and sampled from the leaf centre, had the same tenacity as the deposit of discrete droplets.

Table III

Tenacity of copper oxides of differing deposit type

Fungicide	Surface	Initial deposit (μg. Cu/sq. cm.)	Visual appearance of deposit	Tenacity (× 100) after 60-sec wash
Cuprous oxide	Cellulose acetate	10·9	*a*	10
		8·1	*b*	9
		11·2	*c*	12
	Bean leaf	24·6	*a*	44
		25·2	*b*	41
		23·0	*c*	50
Cupric oxide	Paraffin wax	15·0	*a*	27
		13·6	*b*	22
	Bean leaf	13·5	*c*	32
		35·0	*d*	28

increasing spray time ↓

a. Discrete droplets

b. Droplets coalesced to blotches

c. Just before ' run-off '

d. Continuous film, beyond ' run-off '

(iv) *Influence of initial deposit on tenacity.*—The effect of varying the level of initial deposit was investigated with six copper fungicides on cellulose acetate and with cuprous oxide on paraffin wax. Initial copper deposits within the range 1–55 μg. Cu/sq. cm. were obtained by varying the concentration of the spray suspensions (0·025–1·00% Cu) ; the tenacities after a 60-sec. wash are plotted in Fig. 3. For cupric oxide, copper carbonate and oxychloride (same curve) tenacity was constant over a wide deposit range and then increased with low deposits, whilst the tenacity of cuprous oxide on both cellulose acetate and paraffin wax increased at a constant rate with decreasing deposit. There was a pronounced loss of tenacity with the higher deposits of Bordeaux and Burgundy, both of which have light flocculant suspensions. Bordeaux was anomalous in that it had a maximum tenacity with intermediate deposits and showed a decrease of tenacity with low initial deposits.

(v) *Variation of surface.*—Tenacities of copper fungicides, at approximately equal initial deposits (15–22 μg. Cu/sq. cm.) were determined on artificial and leaf surfaces to investigate the effect of varying the nature of the surface. The data (Table IV) show that at the particular particle size ranges used (Fig. 1) the order of increasing tenacity is independent of surface and is as follows :

copper oxychloride < cupric oxide < copper carbonate < cuprous oxide < Burgundy < Bordeaux

Similarly, comparison of the results on different surfaces for each fungicide also shows a common

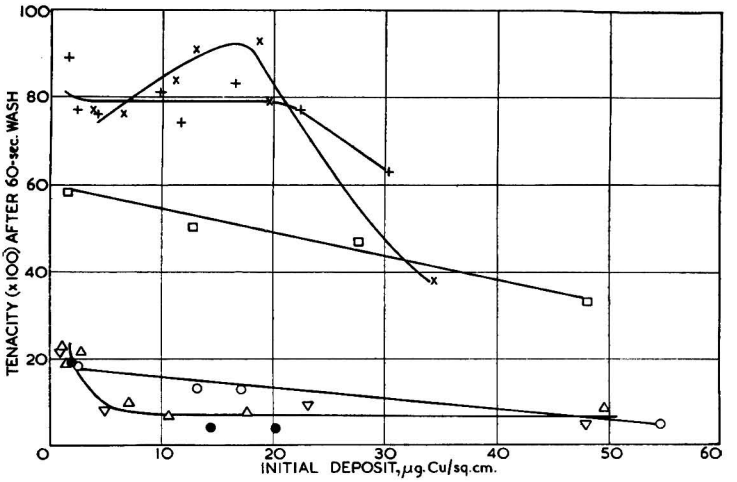

FIG. 3.—*Effect of the level of initial deposit on tenacity*

	Fungicide	Surface
×	Bordeaux	Cellulose acetate
+	Burgundy	,, ,,
□	Cuprous oxide	Paraffin wax
○	Cuprous oxide	Cellulose acetate
△	Cupric oxide	,, ,,
▽	Copper carbonate	,, ,,
●	Copper oxychloride	,, ,,

pattern. In order of increasing fungicide tenacity: for the copper oxides, copper carbonate and oxychloride,

$$\text{cellulose acetate} < \text{tomato} \equiv \text{cauliflower} < \text{paraffin wax} \equiv \text{bean}$$

for Bordeaux and Burgundy.

$$\text{cauliflower} < \text{cellulose acetate} \equiv \text{paraffin wax} \equiv \text{tomato} < \text{bean}$$

The above results show that for the copper oxides, copper carbonate and oxychloride there was a surprising equivalence in tenacity on such dissimilar surfaces as those of tomato and cauliflower leaves, and paraffin wax and bean leaves. The only anomalous results are those for Bordeaux and Burgundy on cauliflower leaves where the reduction in tenacity between the values for 10- and 60-sec. washes suggests that the deposits flaked from the leaf with increased washing.

The tenacity of a deposit on the upper and lower surfaces of leaves was compared. Cuprous oxide deposits (15–22 μg. Cu/sq. cm.) on potato and bean leaves were subjected to a 60-sec. wash. The tenacity (× 100) on the underside of potato foliage was 24 compared with 52 on the upper surface; on bean leaves the corresponding values were 27 and 46 (Table IV), respectively. With bean leaves the under-leaf surface was visibly less wettable than the upper.

The tenacity of a cupric oxide deposit on surfaces of the same material with different degrees of roughness was compared using two types of paraffin wax surface. A smooth, dense wax surface was produced by dipping a glass slide into a wax at 100° and withdrawing it immediately, before the crystals formed initially had melted. A more corrugated surface was obtained by the normal dipping process. Initial deposits of cupric oxide were 19 μg. Cu/sq. cm. for both surfaces and both deposits were subjected to a 60-sec. wash. The tenacity (× 100) for the smooth surface, 19, was slightly less than that on the corrugated surface, 25 (Table IV), but this difference is insufficient to suggest that surface micro-structure is a predominant factor in determining tenacity.

Table IV

Tenacity (× 100) of copper fungicides on artificial and leaf surfaces

Fungicide	Time of wash, sec.	Surface				
		Cellulose acetate	Paraffin wax	Tomato leaf	Cauliflower leaf	Bean leaf
Cuprous oxide	10	15	53	38	34	65
	60	13	45	26	30	46
Cupric oxide	10	8	40	19	16	43
	60	8	25	11	13	30
Copper carbonate	10	12	58	28	17	50
	60	9	32	16	17	31
Copper oxychloride	10	5	44	12	7	37
	60	4	30	8	8	35
Bordeaux	10	90	89	87	100	100
	60	79	83	80	56	97
Burgundy	10	85	91	89	79	96
	60	77	83	73	47	94

The effect of varying wettability of different smooth surfaces on the tenacity of a deposit was investigated for copper oxide deposits on polybutyl methacrylate, cellulose acetate and nitrate. The advancing contact angle of the surfaces against water was taken as a measure of wettability and the results are given in Table V; receding contact angles and the data for paraffin wax are included for reference. The results show that there was a tendency for tenacity to increase with decreasing wettability on these surfaces.

Table V

Tenacity of copper oxides on surfaces of differing wettability

Initial deposit 10–15 μg. Cu/sq. cm.

Surface	Contact angle against water, degrees		Tenacity (× 100) after 60-sec. wash	
	advancing	receding	Cuprous oxide	Cupric oxide
Paraffin wax	110	102	45	25
Polybutyl methacrylate	97	92	37	15
Cellulose nitrate	65	52	15	6
Cellulose acetate	51	46	13	8

(vi) *Physical properties of the fungicide*

(a) *Tenacity and adhesion number relationships.*—Since the copper oxides, copper carbonate and oxychloride used in the above experiments were of different particle size distributions (Fig. 1) it was considered that the behaviour of these fungicides should be compared using particles within a defined size range. A fraction (6 μ and below) of almost identical size distribution of each fungicide was prepared by sedimentation. The tenacities of these suspensions on cellulose acetate were compared with the corresponding values obtained with the original suspensions over the same initial deposit range (10–14 μg. Cu/sq. cm.). Adhesion numbers of the suspensions were also determined. The results given in Table VI show that the tenacities of cuprous oxide and copper carbonate were independent of the particle size range, but with cupric oxide and copper oxychloride the fractions 6 μ and below were much more tenacious than the original suspensions. The adhesion numbers of the two suspensions were identical, probably because on a numerical basis the majority of the particles of the original suspension were 6μ and below, in size.

(b) *Bulk and sedimentation volume.*—Bulk volume, defined as the volume of 1 g. of the dry fungicide in a 10-ml. graduated cylinder after tapping in a standard manner, was compared with the corresponding sedimentation volume (volume of powder after a suspension of 1 g. of fungicide in 10 ml. of water had settled for 24 h.) of each fungicide. Bulk volume is a measure of the

Table VI

Tenacity and adhesion number data on cellulose acetate

Fungicide	Tenacity (× 100) after 60-sec. wash		Adhesion number	
	Original suspension (Fig. 3)	Fraction 6 μ and below	Original suspension	Fraction 6 μ and below
Cuprous oxide	13	9	57	56
Copper carbonate	9	11	52	45
Cupric oxide	8	29	29	28
Copper oxychloride	4	23	45	48

porosity and cohesion of the dry powder and the sedimentation volume is a measure of its cohesion in water. The results (Table VII) show the constancy of the ratio of these two quantities, which suggests that water affected the cohesion of the fungicides in the same manner.

Table VII

Bulk and sedimentation volume of copper fungicides

Fungicide	Volume (ml.) of 1 g. of fungicide		Ratio A/B
	*Bulk (A)	*Sedimentation (B)	
Cuprous oxide	0·6	1·0	0·60
Cupric oxide	1·8	2·4	0·75
Copper carbonate	2·2	3·7	0·60
Copper oxychloride	1·4	2·1	0·67

* Mean of duplicate determinations which did not differ by $>$ 0·1 ml.

(c) *Tenacity and fungitoxicity of different size fractions of cupric oxide.*—Fractions of cupric oxide, 3 μ and below, 6 μ and below, 24–48 μ, and 50–200 μ were prepared with at least 95% by weight of the particles within the range limits. The diameters of the particle of mean weight, defined as $\left(\frac{\Sigma\, nd^3}{\Sigma\, n}\right)^{1/3}$ where n is the total number of particles of diameter d in the sample, were 1·5, 5·0, 27·8, and 53·2 μ, respectively, for the four fractions. The tenacities on cellulose acetate of these fractions, plotted in Fig. 4 (initial deposits 10–15 μg. Cu/sq. cm.), increased rapidly with decreasing particle size.

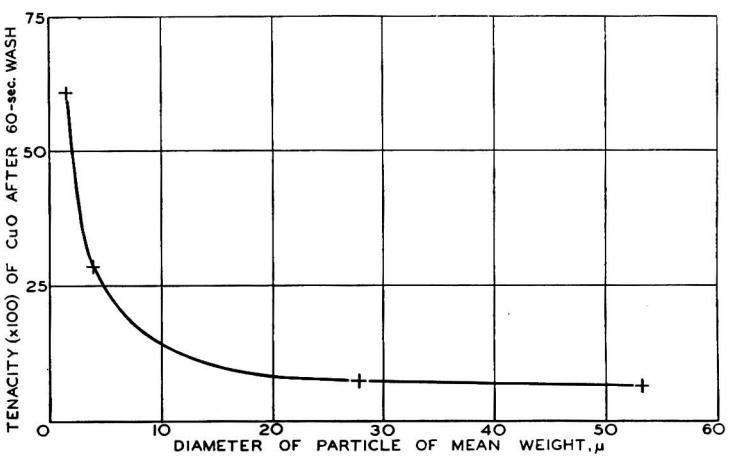

FIG. 4.—*Relationship between tenacity and particle size (cupric oxide on cellulose acetate)*

The fungitoxicities of the fractions of size 3 μ and below, 6 μ and below, and 24–48 μ against *Alternaria tenuis* were compared with that of the original cupric oxide suspension in two separate

experiments. The equations of the computed probit regression lines, and the relative potencies for the parallel lines, are given in Table VIII. The fractions gave an increased fungitoxicity with decreasing particle size and although the fractions 3 μ and below, and 6 μ and below cannot be compared exactly (as the regression lines for *a* were not quite parallel) the data suggest that they were of equivalent potency. Because of the very small copper deposits required for the dosage–response tests it was not possible to conduct a bioassay on the 50–200-μ fraction.

Table VIII

Dosage–response data : different size fractions of cupric oxide tested against Alternaria tenuis

Size fraction	Equation of line	ED_{50} ($\times 10^{-4}$ μg. Cu/spore)	Relative potency	95% fiducial limits
(*a*) Original	$y = 4{\cdot}92x + 1{\cdot}88$ *(3·98 — 5·86)	4·30	†	†
3 μ and below	$y = 3{\cdot}53x + 3{\cdot}48$ *(3·04 — 4·02)	2·69	†	†
(*b*) Original	$y = 4{\cdot}60x + 1{\cdot}75$	5·09	1·00	—
6 μ and below	$y = 4{\cdot}60x + 2{\cdot}81$	2·99	1·70	1·41 — 2·05
24–48 μ	$y = 4{\cdot}60x + 0{\cdot}90$	7·81	0·65	0·54 — 0·79

* 95% limits of the slope
† Dosage–response lines not parallel

(vii) *Comparison of the weathering action of wind and rain in a field trial*

In 1954 a field trial was carried out on bean foliage to compare the weathering of cuprous oxide and Burgundy spray deposits by rain alone, wind alone, and complete weathering. Protective cages similar in design to those of Hopkins *et al.*[8] were placed over some of the plants so that they were exposed to only one type of weathering process. The tenacities of the deposits were determined at two sampling dates.

Plot lay-out.—The plot consisted of ten rows, each of 100 plants, of broad bean (var. White Harlington) situated on an exposed slope and at right angles to the prevailing S.W. wind. Alternate halves of alternate rows were divided into five randomized blocks, each consisting of six individual plots. One of the six treatments in Table X was applied to each of these plots. Three plants were removed between each plot to minimize sheltering effects.

Spray treatments.—Cuprous oxide and 10 : 11·4 : 100 Burgundy mixture, both at 0·25% Cu, were applied with a hand-pump spray to beyond ' run-off '. Gelatin (0·1%) was added to both sprays to stabilize the suspensions and enhance wetting. The sprays were applied on 3 June.

Types of weathering

Rain alone.—Three plants were enclosed in a glass-sided box without a top, 45 × 25 cm. and 50 cm. high. The box was secured with wooden stakes and sheltered the plants from the wind whilst exposing them to all, except low-angle, rain.

Wind alone.—A horizontal sheet of glass, 60 × 60 cm., held in a frame and at 60 cm. from the ground, covered the top of three plants from all except horizontal rain but allowed unrestricted access to the wind.

Complete weathering.—Ten unprotected plants were used as controls.

The boxes were erected over the plants as soon as the spray deposit had dried and the growing points of the plants were cut off to prevent growth out of the boxes.

Sampling and analysis of the spray residue. For increased precision, the initial deposit was determined by applying each of the spray treatments to 50 plants in one of the guard rows. Eight samples of 25 leaves were taken for each treatment and discs (2·50 cm. diameter) were cut from the leaves, ashed, and analysed for copper.[3] For the deposit residues, 25 leaves per plot were taken for the ' complete weathering ' treatment and 15 leaves per plot for the other treatments. There was only slight growth of the sprayed leaves over the period of the experiment and no attempt was made to calculate the loss of deposit from this cause ; new foliage was easily distinguishable.

A summary of relevant weather records is given in Table IX.

Table IX

Weather data, June 1954

	3–11 June	11–30 June
Rainfall, in.	3·14	1·15
Wind velocity (total in h.)		
0–3 m.p.h.	36	89
4–12 m.p.h.	105	339
13–24 m.p.h.	58	70
General wind direction	W.S.W. (80%) E.N.E. (20%)	S.W.

Results

Initial deposits.—These were (as mg. Cu/100 sq. cm. of leaf) :

$$\text{Cuprous oxide} = 2{\cdot}74 \pm 0{\cdot}24$$
$$\text{Burgundy} = 2{\cdot}50 \pm 0{\cdot}50$$

where the limits for the means are approximate 95% confidence limits (i.e., ±2 S.E.). The deposits are not significantly different at the 5% level.

Weathered residues.—Table X gives the copper content of the spray residues, with approximate 95% confidence limits of the means ; the tenacities associated with the different treatments are plotted in Fig. 5. The tenacities were transformed to ' angles of equal information ' and treated by an analysis of variance, the significant differences between the weathering treatments are also given. Wind was less effective than rain in removing spray deposits. There was no significant difference (at 5% level) between any of the tenacities of cuprous oxide and Burgundy with the same weathering treatment, except for the tenacities with ' wind alone ' sampled on 11 June. This result may have been due to the presence of gelatin as a spray supplement.

Table X

Effect of different types of weathering on cuprous oxide and Burgundy deposits on broad bean leaves, 1954

Spray treatment	Type of weathering	Residue (mg. Cu/100 sq. cm. of leaf) 11 June	30 June
Cuprous oxide	Rain (R)	0·86 ± 0·20	0·76 ± 0·44
	Wind (W)	2·06 ± 0·44	1·23 ± 0·45
	Complete (C)	0·50 ± 0·18	0·20 ± 0·10
Burgundy	Rain	0·68 ± 0·16	0·62 ± 0·23
	Wind	1·14 ± 0·50	0·98 ± 0·21
	Complete	0·24 ± 0·13	0·10 ± 0·04

Significant differences between the tenacities of the above treatments

11 *June*

Cuprous oxide : W > R, C***
Burgundy : R > C*, W > C***

30 *June*

Cuprous oxide : R > C**, W > C***, W > R*
Burgundy : R, W > C***, W > R*

*** Significant at P = 0·001
** ,, ,, P = 0·01
* ,, ,, P = 0·05

Discussion

The tenacity of a spray deposit is determined by the interaction of the fields of force at the surface of the particles with each other, and with those at the surface to which the particles adhere. These forces are likely to differ in the cases of spray deposits and dust deposits of the

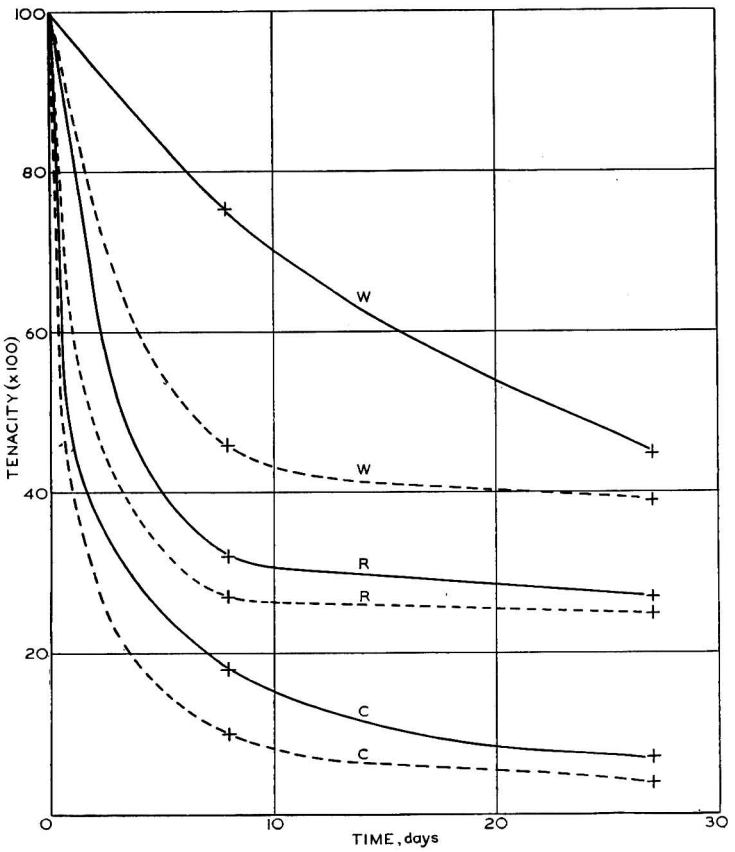

FIG. 5.—*Tenacity of cuprous oxide and Burgundy deposits on bean, exposed to different types of weathering*

——— Cuprous oxide
- - - - - - - - - Burgundy
W—Wind
R—Rain
C—Complete weathering

same material, and qualitative experiments with copper fungicide dusts have shown that their tenacity on cellulose acetate is very low compared with that of spray deposits. This suggests that the wetting and subsequent drying of the particles aid their adhesion to each other, and to the sprayed surface. The present work indicates that prolonging the drying for 144 h. at 25°, or for 24 h. at 45° does not affect the tenacity of the deposits, and confirms the work of Kirk[9] who found no difference between the tenacities of DDT formulations on potato foliage dried for 24, 48 or 72 h. before washing.

It seems likely that copper fungicide particles in aqueous suspension are surrounded by a sheath of water molecules (cf. von Buzágh[10]), which may be largely retained on drying and so will influence the tenacity of the spray deposit. There is also the possibility of chemical reaction involving the fungicide deposit and leaf surface,[1] but at present it is difficult to assess the relative importance of these theories in interpreting the process of the adherence of a spray deposit.

Turner & Woodruff,[11] and Rich[4] have considered the relation between the magnitude of a spray deposit and its tenacity. They suggested that the smaller the deposit the greater is the importance of the particle–surface adhesion, but with increasing thickness of deposit particle–particle cohesion predominantly influences the tenacity. The present work shows that with all the copper fungicides (except Bordeaux) their adhesion to cellulose acetate was greater than their

cohesive forces, for their tenacity decreased with increasing initial deposit. The opposite behaviour shown by Bordeaux at low initial deposits, suggests that its cohesive forces are greater than its adhesion to cellulose acetate and Rich,[4] who obtained similar results, suggested that the high cohesive forces between the Bordeaux particles are related to their degree of hydration in suspension.

It was thought possible that the adhesion numbers, and the bulk and sedimentation volumes of the copper fungicides, would give a measure of the particle–surface adhesion and particle–particle cohesion, respectively, of these materials. However, the adhesion numbers in Table VI appear to be unrelated to the tenacity of either the original suspension or fractions of 6 μ and below (initial deposits 10–14 μg. Cu/sq. cm.), or to the tenacity of deposits of less than 2 μg. Cu/sq. cm. (Fig. 3) where the particle–surface adhesion is more important. The tenacities of these latter deposits were almost identical, whilst the adhesion numbers varied from 29 to 57. The differences between the cohesive forces of the fungicides observed in Table VII are obviously not large enough to influence the general form of their tenacity–initial deposit plots (Fig. 3).

Fajans & Martin[2] have suggested that the tenacity of a deposit increases with decreasing wettability of the surface, but although there was a tendency for tenacity to increase with increasing contact angle on artificial surfaces, the present results show that the readily wettable bean leaf yielded the most tenacious residues. Rich[4] found that Bordeaux and zineb residues were more effectively held by the hairy type of bean foliage than by smooth celery foliage, but the present investigation has shown that fungicide deposits on tomato leaf and the underside of potato leaf, both of which are very hairy, were less tenacious than similar deposits on such smooth leaves as those of broad bean and cauliflower. Fogg[12] showed that the wettability of detached leaves decreased on wilting and the fact that the tenacity of deposits which had dried on the plant did not differ from the tenacity of deposits formed on detached leaves suggests that the physical structure of the surface is less important than its chemical nature in determining the tenacity of a deposit. This was also corroborated by the data for the tenacity of cupric oxide on smooth and corrugated paraffin wax. Further work is required for a fuller understanding of the effect of different surfaces on the tenacity of a fungicide.

Constant tenacity values are shown in Table III (initial deposits of the order of those used in the field) irrespective of the type of spray deposit. These results have a practical importance now that low-volume sprays are replacing those of high-volume. The present work suggests that the tenacity of the discrete deposits produced by the latter will be no less tenacious than those from ' run-off ' sprays. The tenacities of these different types of deposit at the same surface concentration do not seem to have been previously compared.

Horsfall[1] suggested that the tenacity of a deposit is inversely proportional to the logarithm of the rainfall to which it is exposed. Since the logarithm of the rainfall is used, this relationship can be applied only after the exposure of the deposit to a finite amount of rain and so gives no information on the initial loss of deposit. Trivelli,[13] however, found that the loss of a fungicide deposit was a logarithmic function of the time of wash, i.e. log (deposit) $= a - b$(rainfall), where a and b are constants. With the present experimental results, this relationship holds only for Bordeaux and Burgundy deposits (except on cauliflower leaves). In general, the other fungicides washed off the surfaces with a rapid decrease of deposit in the first few seconds of washing and little further loss with increased washing (Fig. 2).

The relative importance of wind and rain in the weathering of a spray deposit does not seem to have been determined for fungicide deposits, although the generally accepted view is that ' in most climates rain and dew are the main agents reducing spray residues '.[14] Hopkins *et al.*[8] determined the separate weathering effects of wind and rain for DDT dusts on clover and found that, although wind was initially less efficient than rain in removing the deposits, the effect of wind was more prolonged. The present field trial has shown that wind was an important factor in the weathering of cuprous oxide and Burgundy spray deposits, reducing the deposits by more than 50% after 27 days' exposure. Fig. 5 suggests that the wind and complete weathering treatments had a more prolonged effect than rain alone, although these differences were not quite significant at the 5% level. When wind and rain combined to give complete weathering, their effects were additive which also suggests that wind removed the final tenaciously-held residue.

Previous work[1, 15, 16] has shown that the tenacity of a fungicide deposit increases with decreasing particle size. The increased tenacity of the smaller particles is probably due to their greater relative surface area (hence greater relative surface forces) per unit weight and to their greater deformability[17] as compared with the larger particles. In the present work, only with cupric oxide and copper oxychloride was the tenacity of the fraction 6μ and below greater than that of the original powders. If the above hypothesis is correct, it would seem that deformability is the more important of the two properties mentioned in affecting tenacity and that the deformability of cuprous oxide and copper carbonate particles does not increase with decreasing particle size, and it is interesting to note that Horsfall[1] also found the tenacity of cuprous oxide to be independent of particle size, although Hyre[15] reported that the tenacity of copper carbonate increased with decreasing particle size.

The fungitoxicity of cupric oxide did not increase with decreasing particle size below 6 μ indicating that the surface had become ' saturated '[18] with the fraction of the fungicide of size 6 μ and below. As the tenacity of cupric oxide increased rapidly with decreasing particle size, a deposit of variable particle size would be expected to weather differentially, the larger particles being removed first. Thus the initial loss of cupric oxide deposit might affect the fungitoxicity of the residue only slightly. It seems that a knowledge of the exact relationship between the tenacity and fungitoxicity of a fungicide is required to predict its field performance.

Acknowledgments

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THE ABSORPTION OF OXYGEN FROM AIR BY FLOUR BATTERS: CHANGES IN THE RATE OF UPTAKE DUE TO AGEING OF THE FLOUR

By D. J. COSGROVE*

Measurements have been made of the rate of absorption of oxygen from air, at 25°, by suspensions of flour in a phosphate buffer solution (pH 6·5). The effects of storage in air and nitrogen have been examined.

Introduction

Considerable interest has been shown in recent years in the ' batter ' or aeration process of Rank & Hay[1] as a possible alternative to the use of chemical agents for the improvement of flour. In this process flour and water mixtures are beaten at high speed in a specially designed machine before being made into a dough, with or without the incorporation of a very small quantity of soya meal. The resulting loaves are whiter and have a better volume and texture as a result of the treatment.

It was suggested[2] that the bleaching effect obtained was due to enzymes of the lipoxidase type, whereas the improvement was variously ascribed to the physical effects of ' work strengthening ' of the flour gluten or to the action of oxidizing enzymes. Recent work by Todd, Hawthorn & Blain[3] has led them to conclude that while the bleaching effect is largely or entirely catalysed by lipoxidase or other fat oxidases which require the presence of molecular oxygen, the improvement is independent of the bleach and is due to the increased access of oxygen brought about by high-speed mixing.

It was considered that a study of the rate of uptake of oxygen by flour suspensions while being subjected to vigorous stirring should throw some light on the mechanism of the process. Accordingly, an apparatus was designed for this purpose and some preliminary results obtained with it are presented here. The flour batters studied here are somewhat more dilute than those used in the ' aeration ' process.

Experimental

Apparatus

The apparatus used for the determination of oxygen uptake is shown in Fig. 1. The batter under examination is contained in a heavy-wall conical flask and stirred by a magnetic device, the stirrer being a bundle of soft iron wire sealed inside a length of glass tubing. The large manometer contains mercury and the small one Kreb's manometer fluid. The whole apparatus is supported in a glass thermostat tank containing water and maintained at 25 $\pm$ 0·05° by means of a mercury control and Sunvic relay, the heaters being two carbon filament lamps. The mercury manometer is calibrated by measuring the increase in height of the meniscus in the right-hand limb brought about by addition of known weights of mercury (1 mm. $\equiv$ 0·0549 ml.).

Experiments with the apparatus are carried out in the following manner:

The apparatus is partially evacuated from tap T_1 until the mercury level in the right hand limb of the manometer is near the bottom of the U-tube.

The stirrer is placed in the conical flask together with 40 ml. of phosphate buffer solution (pH 6·5, prepared by mixing 3 parts of M/15-disodium hydrogen phosphate with 7 parts of M/15 potassium dihydrogen phosphate), and the air flushed out of the flask with nitrogen. The flour to be examined (25 g.) is then added and the connecting head, whose joints have been previously lubricated with a 1 : 1 mixture of lanolin and petroleum jelly, placed on the flask. The cup attached to the connecting head contains a strip of fluted hard filter paper and 2 ml. of 20% potassium hydroxide solution to absorb any traces of carbon dioxide evolved. The apparatus is assembled and then slowly evacuated by means of a water pump through the two-way tap. It is

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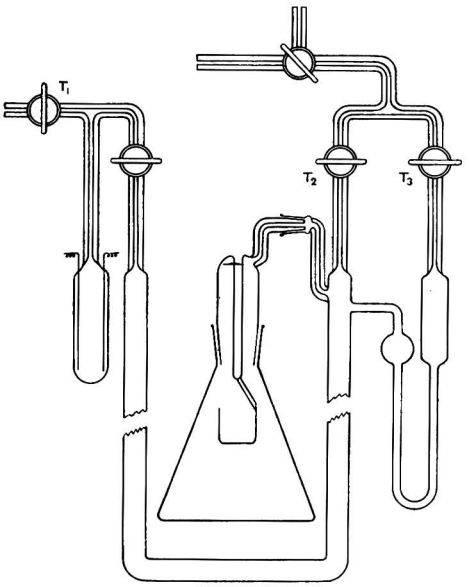

FIG. 1.—*Apparatus*

then slowly filled with nitrogen, re-evacuated and filled with nitrogen again to atmospheric pressure. The batter is stirred in its atmosphere of nitrogen for five minutes, by which time it is smooth and free from lumps. Stirring is stopped and the apparatus evacuated as before ; this time it is allowed to fill slowly with air through the two-way tap until atmospheric pressure is reached. After allowing a few minutes for the air in the apparatus to reach thermostat temperature, the taps T_2 and T_3 are closed, a vernier microscope reading is made on the mercury meniscus in the right hand limb and the stirrer started. Readings are taken at appropriate intervals by adjusting the limbs of the small manometer to the same height and reading off the distance the mercury meniscus has to be raised to achieve this. The mercury meniscus is raised by generating gas in the small electrolytic cell shown on the left-hand side of the apparatus. The meniscus of one arm of the small manometer is observed through a fixed crosswire microscope.

Preparation of flour samples

Most of the flour samples used were milled on a laboratory Buhler mill at 70–75% extraction, using as grist a good grade of Manitoba wheat. The sample MEF/1 was milled at 63% extraction from a mixed English grist on a laboratory Miag mill, and MEF/2 was Buhler-milled at 70–75% from the same grist.

The ' redeposited fat ' samples were prepared by extracting freshly milled flour (F/3) and a similar weight of two-months-old flour (AF/1) with cold light petroleum (b.p. 40–60°). The extract from F/3 was added to the defatted AF/1 (Sample AF/1/Fat F/3) and that from AF/1 added to F/3 (Sample F/3/Fat AF/1). The solvent was evaporated at room temperature by evacuating a flask containing the sample at the water pump. The sample R/AF/1 was prepared by shaking the flour with the solvent and then evaporating at the pump as before.

The samples required for the nitrogen storage experiments were contained in conical flasks in a large desiccator—without desiccant. The desiccator was evacuated by a Hyvac pump for 15 minutes and then filled with nitrogen at atmospheric pressure. It was re-evacuated and filled again with nitrogen then stored in this condition until the samples were required for examination. Heat-treated samples were prepared by oven heating a screw-topped bottle containing the sample at the desired temperature for the required time. All the samples were stored at room temperature.

Results

Changes in the rate of uptake of oxygen by a batter, brought about by storage of the flour (F/3) in air, are shown in Fig. 2. The sample was examined at intervals over a period of 3–4 months from the date of milling. The results of a similar experiment using the English flour (MEF/1) are also shown in Fig. 2. In Fig. 3 are shown the absorption curves of the samples AF/1/Fat F/3, F/3/Fat AF/1, and R/AF/1 all of which were examined on the same day.

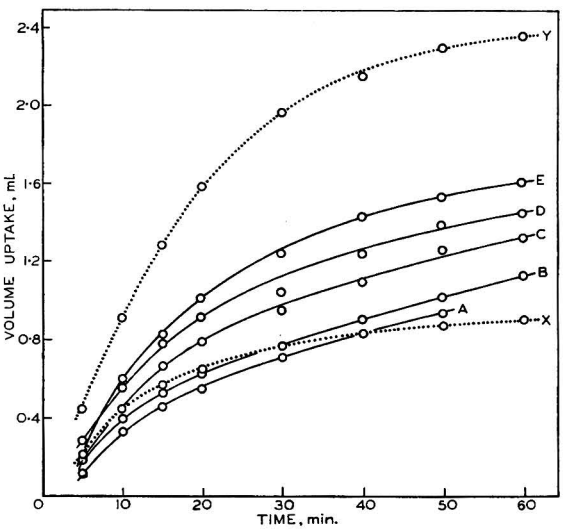

FIG. 2.—*Absorption curves of Manitoba flour*, F/3, *stored in air*

A. Day of milling
B. After storage for 7 days
C. " " " 16 "
D. " " " 36 "
E. { " " " 62 "
" " " 110 "

Absorption curves of English flour, MEF/L, stored in air

X. Day of milling
Y. After storage for 150 days

In Fig. 4 are presented the absorption curves of a 4-month-old sample of flour (MEF/2) and the same flour after extraction with cold light petroleum (b.p. 40–60°). The results of an experiment on heat treatment of air stored flour (F/3) are also shown in Fig. 4. The absorption curves are those for a sample of F/3 which had been defatted, heated at 100° for 1 hour, and the fat replaced, and for a sample which had been defatted and the fat replaced without any heat treatment.

Discussion

It has been shown that the ability of a flour batter to absorb oxygen when stirred rapidly is dependent on the age of the flour and increases steadily to a maximum value. In the case of the Manitoba sample studied this value was reached 2–3 months after the date of milling (see Fig. 2). A similar effect was noticed in a less detailed experiment on English white flour. In another experiment the effect of storage in nitrogen was found rather unexpectedly to be qualitatively similar to that of air storage. It is probable that the flour has been affected by the traces of oxygen always present in cylinder nitrogen. It has been shown (Irvine[4]) that the 'zero order' phase of lipoxidase oxidation (Irvine & Anderson[5]) can continue in an atmosphere of cylinder nitrogen but not in pure helium.

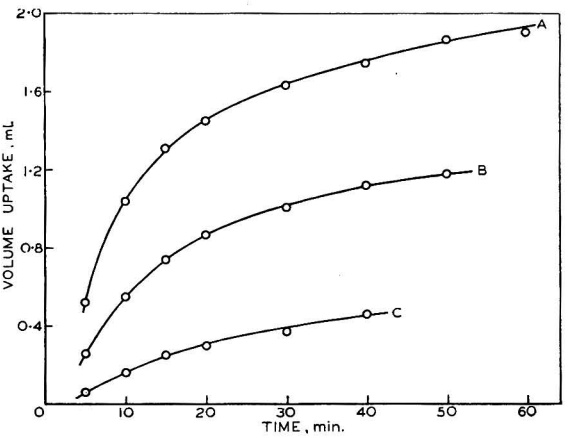

FIG. 3.—*Absorption curves of 'Redeposited' samples*

A. R/AF/1
B. F/3/Fat AF/1
C. AF/1/Fat F/3

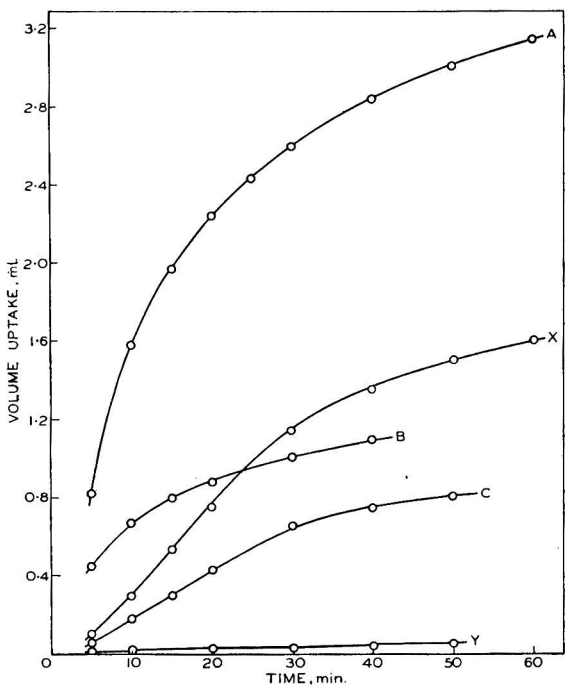

FIG. 4.—*Effect of extraction with light petroleum on the absorption rate*

A. After 4 months' storage in air
B. Day of milling
C. After 4 months' storage followed by light petroleum extraction

The effect of heat treatment on the absorption rates of Manitoba flour (F/3)

X. Fat extracted with light petroleum and replaced
Y. Fat extracted as X, flour heat-treated, fat replaced

Light petroleum extraction of the flour markedly reduces the ability of the batter to take up oxygen, as shown in Fig. 4. This result coupled with those shown in Fig. 3 can most readily be interpreted by postulating a change in the flour fat on storage. If the increased ability to take up oxygen were due to changes taking place in non-fatty constituents then the difference between curves A and C in Fig. 4 would not be great. An increase of lipoxidase activity with age is largely ruled out by the results shown in Fig. 3 as, if the fat were unchanged with age, there would not be any great difference between curves A and C.

The results in Fig. 4 show that the oxygen-absorbing ability of flour which has been defatted, heat treated and had the fat redeposited on it is insignificant, a result to be expected if the absorption effect is due to such an enzyme as lipoxidase. The lipoxidase activity of flour has been extensively studied by Irvine & Anderson,[5] who measured it by a manometric method using a synthetic substrate based on linoleic acid.

The importance of these results will be realized when it is remembered that the baking qualities of flour increase with storage, up to a certain point; a study of the relationship of the two effects is an obvious extension of this work. Treatment of flour with chemical improvers such as agene, chlorine and chlorine dioxide has an immediate oxidizing effect on the flour lipids (Moran, Pace & McDermott[6]) and it is also proposed to examine the effect of improving agents such as these on the oxygen-absorbing ability of flour.

The mechanism of bleaching and improvement by means of the 'batter' process of Rank & Hay[1] is still largely uncertain. Bleaching is presumably by coupled oxidation of the carotenoids through fat oxidation by lipoxidase, but Todd, Hawthorn & Blain[3] do not consider that a similar mechanism is responsible for the improvement effect. Their viewpoint is founded on experiments showing that improvement takes place when defatted flour is used in the 'batter' process. It must however be pointed out that extraction with light petroleum does not remove all the lipids from flour and that, as shown in Fig. 4, batters made from such flour are capable of absorbing some oxygen. This might be responsible for some of the improvement effect. (See also Cookson & Coppock.[7])

Methods for extraction of fat from flour batters are being developed in these laboratories and it is anticipated that their use will enable oxygen uptake measurements to be correlated with data on the degree of peroxidation of the fat, thus throwing more light on the mechanism of improvement by batter oxidation.

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Received 13 January, 1956

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EFFECT OF A FUNGICIDAL WAX COATING ON THE STORAGE BEHAVIOUR OF MANGOES

By P. B. MATHUR and H. SUBRAMANYAM

Badami (Alphonso) mangoes were dipped in 1·7–2·7% aqueous emulsions of a fungicidal wax containing 5% of *o*-phenylphenol* and after drying in a current of hot air the fruit was stored at 79–86° F and R.H. 55–87%. The treatment was found to lessen the physiological losses in weight, increase the retentions of vitamin C and moisture, delay ripening, decrease the percentage wastage and increase the storage life of the fruit.

Recent researches have shown that skin coatings of various types with and without an added fungicide may increase the storage lives of fruits and vegetables in non-refrigerated storage to a considerable degree.[1–6] In the present investigation the effects of a fungicidal wax coating on the storage behaviour of Badami (Alphonso) mangoes in non-refrigerated storage have been studied.

Experimental

The fruits for this investigation were picked from an orchard 27 miles from Mysore and were fully-grown and green corresponding to Stage B of Cheema & Dani[7] (the shoulders had outgrown the stem end and the colour of the fruit was olive green) and Stage 2 of Wardlaw & Leonard[8] (shoulders had risen above the hollow in which the stem end is inserted). On the next day following their arrival in the Laboratory, they were divided into four lots of 250 fruits each.

Three lots were treated with an aqueous fungicidal wax emulsion, containing, respectively, 1·7%, 2·2% and 2·7% solids, and one lot was used as the control. The composition by weight of the fungicidal wax was as follows: micro-crystalline petroleum wax, 40 parts; low melting point, thermoplastic terpene resin, 31 parts; oleic acid, 7 parts; triethanolamine, 17 parts and *o*-phenylphenol, 5 parts. The fruits were dipped in the fungicidal wax emulsion for one minute, drained and dried in a current of hot air (temp., 100–125° F) for 3–4 minutes. All the lots of fruits were stored at room temperature (79–86° F; R.H. 55–87%).

The fruits were analysed by methods indicated under the tables of results, after various periods of storage.

Results

The results obtained are shown in Tables I–VII and Figs. 1 and 2.

The physiological losses in weight in mangoes during storage were found to decrease with treatment with emulsions containing increasing quantities of the fungicidal wax (Table I).

Table I

Cumulative percentage physiological† losses in weight in Badami mangoes during storage (means of 6 estimations

Treatment	Mean wt. of a single fruit, g.	% loss on storage				
		4 days	8 days	12 days	16 days	20 days
(1) Control	353·8	3·6	10·0	15·8	19·6	22·0
(2) Wax emulsion, 1·7% solids	343·7	3·5	8·9	12·5	15·4	17·6
(3) Wax emulsion, 2·2% solids	331·6	3·3	8·0	11·9	14·8	16·9
(4) Wax emulsion, 2·7% solids	356·3	3·3	6·7	9·9	12·9	15·2

† Losses in weight due to respiration and transpiration

It is seen from Tables II and III that the percentages of total soluble solids increase and the percentages of acidity decrease during storage in mangoes. Since increases in total soluble solids and decreases in acidity are known to be associated with ripening in mangoes,[9, 10] the data presented in Tables II and III indicate that treatment with increasing concentrations of the fungicidal wax emulsion has a progressively delaying effect on ripening of the fruit.

* *Editor's note.* The use of such fungicidal substances in fruits is contrary to the Preservatives Regulations of the U.K.

Table II

Changes in % of total soluble solids (fresh weight basis) in Badami mangoes during storage*

(The data in parentheses represent values calculated on original fresh weight basis at the end of the storage period)

Treatment	Original value %	After storage				
		4 days %	8 days %	12 days %	16 days %	20 days %
(1) Control	9	10	12	14	16	18 (16·92)
(2) Wax emulsion, 1·7% solids	9	9	12	14	16	18 (17·10)
(3) Wax emulsion, 2·2% solids	9	9	10	13	15	17 (16·32)
(4) Wax emulsion, 2·7% solids	9	9	10	12	14	17 (16·49)

* Estimated by refractometer

Table III

Changes in total acidity (as malic acid, fresh weight basis) in Badami mangoes during storage*

(The data in parentheses represent values calculated on original fresh weight basis at the end of the storage period)

Treatment	Original value %	After storage				
		4 days %	8 days %	12 days %	16 days %	20 days %
(1) Control	4·00	3·20	1·89	0·84	0·20	0·16 (0·15)
(2) Wax emulsion, 1·7% solids	4·00	3·24	2·00	1·20	0·26	0·19 (0·18)
(3) Wax emulsion, 2·2% solids	4·00	3·30	2·10	1·24	0·28	0·20 (0·19)
(4) Wax emulsion, 2·7% solids	4·00	3·30	2·16	1·28	0·31	0·24 (0·23)

* Estimated by titration of an aqueous extract with 0·1N-NaOH and calculated as malic acid

Treatment with increasing concentrations of the fungicidal wax emulsion resulted in progressively greater retentions in the contents of vitamin C and moisture in mangoes during storage (Tables IV and V).

Table IV

Changes in vitamin C content (mg./100 g. of fresh weight) of the edible portion of Badami mangoes during storage*

(The data in parentheses represent values calculated on original fresh weight basis at the end of the storage period)

Treatment	Original value	After storage				
		4 days	8 days	12 days	16 days	20 days
(1) Control	258	186	120	94	70	48 (45·1)
(2) Wax emulsion, 1·7% solids	258	190	128	99	71	54 (51·3)
(3) Wax emulsion, 2·2% solids	258	191	132	100	72	60 (57·6)
(4) Wax emulsion, 2·7% solids	258	200	148	102	82	64 (62·1)

* Estimated by titration against a standard solution of 2 : 6-dichlorophenolindophenol

Table V

Percentage moisture contents in Badami mangoes at the commencement and the end of the storage period*

Treatment	Original %	After 20 days %
(1) Control	81	75
(2) Wax emulsion, 1·7% solids	81	76
(3) Wax emulsion, 2·2% solids	81	77
(4) Wax emulsion, 2·7% solids	81	78

* 10 g. of edible portion dried at 75° for 16 hours

The ripening rate in the case of mangoes treated with the emulsion with the highest concentration of the fungicidal wax, viz., 2·7% solids, was significantly slower as compared with the control (Table VI).

Table VI

Percentages of mangoes found in the green stage at the end of 20 days of storage

Treatment	Number of fruits in the green stage		% green fruits	% green fruits after transformation*
	Replication 1 (50 fruits)	Replication 2 (50 fruits)		
(1) Control	0	3	3	1·52
(2) Wax emulsion, 1·7% solids	1	2	3	2·91
(3) Wax emulsion, 2·2% solids	3	5	8	7·89
(4) Wax emulsion, 2·7% solids	11	15	26	25·90

* The percentages have been converted into angles by the formula, angle = $\sin^{-1}$ percentage

Statistical remarks

(*a*) The difference between emulsion with 2·7% solids and control is significant at 2% level.
(*b*) The differences between emulsions with 2·7% solids on the one hand and 1·7% solids and 2·2% solids on the other are significant at 5% level.
(*c*) Other differences are not significant.
(*d*) S.E. of the treatment means(transformed variates) = 4·02(4 d.f.).

The percentage wastage due to diseases was significantly lower in the case of mangoes treated with the emulsion containing the greatest quantity of the fungicidal wax (2·7% solids) as compared with the control (Table VII). The respiration rates measured at 95° F in variously-treated mangoes during storage have been plotted in Fig. 1. After the 6th day of storage the control fruit had the highest rate of respiration followed by treatments 2, 3 and 4. The climacteric rises in respiration rates characteristic of senescent fruits[10, 11] are apparent in all the four curves. The peak rates of respiration occurred on the 12th day in treatments 1, 2 and 3 and on the 16th day in treatment 4. The upper part of Fig. 1 shows the changes in the colour of the skins of the same fruits which were used for the measurement of respiration rates. It is obvious that the peak rate of respiration corresponds with the greenish-yellow stage during the ripening of Badami (Alphonso) mangoes.

Table VII

Percentage wastage due to diseases in Badami mangoes at the end of 20 days of storage

Treatment	Number of diseased fruits		% wastage	% wastage after transformation*
	Replication 1 (50 fruits)	Replication 2 (50 fruits)		
(1) Control	17	19	36	36
(2) Wax emulsion, 1·7% solids	15	14	29	29
(3) Wax emulsion, 2·2% solids	12	13	25	25
(4) Wax emulsion, 2·7% solids	5	6	11	11

* Same formula was employed as for Table VI

Statistical remarks

(*a*) The difference between treatment with wax emulsions containing 2·7% solids and control is significant at 0·1% level.
(*b*) The differences between treatment with wax emulsions containing 2·7% solids on the one hand and 1·7% and 2·2% solids on the other are significant at 0·1% level.
(*c*) The difference between treatment with wax emulsions containing 1·7% solids and control is significant at 5% level.
(*d*) The difference between control and treatment with wax emulsion containing 2·2% solids is significant at 1% level.
(*e*) The difference between treatment with wax emulsions containing 1·7% and 2·2% solids is not significant.
(*f*) S.E. of the treatment means(transformed variates) = 0·88(4 d.f.).

The data with regard to percentage wastage due to diseases have been plotted in Fig. 2. A line has been drawn at 10% wastage level intersecting the various curves. At 10% wastage basis, the storage lives of the variously-treated mangoes are: (i) control, 12½ days; (ii) wax emulsion—1·7% solids, 13½ days; (iii) wax emulsion—2·2% solids, 14½ days and (iv) wax emulsion—2·7% solids, 19 days. It is thus obvious that treatment with the emulsion containing the greatest quantity of the fungicidal wax, viz., 2·7% solids, has resulted in increasing the storage life in non-refrigerated storage (79–86° F; R.H. 55–87%) of Badami mangoes by about

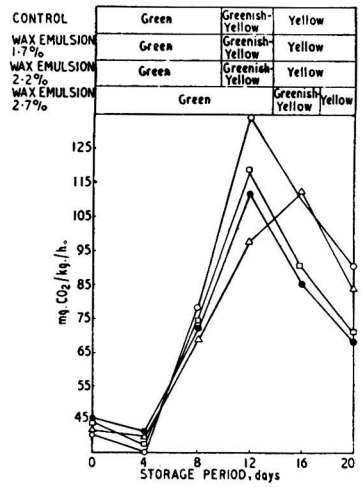

FIG. 1.—*Respiration rates measured at 95° F in variously-treated mangoes during storage*

The upper part of the diagram shows the changes in the colour of the skins of the same fruits which were used for the measurement of respiration rates

○ Control
□ Wax emulsion 1·7%
● Wax emulsion 2·2%
△ Wax emulsion 2·7%

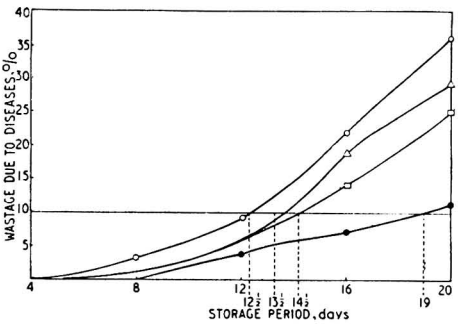

FIG. 2.—*Percentage wastage in variously-treated mangoes during storage*

○ Control
△ Wax emulsion 1·7%
□ Wax emulsion 2·2%
● Wax emulsion 2·7%

50%. It is interesting to note in this connexion that Hall *et al.*[1] recorded an increase of about 50% in the storage life of Granny Smith apples in non-refrigerated storage with the aid of an application of an 8–10% alcoholic solution of 2 parts of castor oil and 1 part of wax-free shellac.

Acknowledgments

Our thanks are due to Dr. V. Subrahmanyam, Director, for his keen interest in these investigations. Our thanks are also due to Mr. A. N. Sankaran for the statistical analysis of part of the data.

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JOURNAL OF THE SCIENCE OF FOOD AND AGRICULTURE

ABSTRACTS

OCTOBER, 1956

The general arrangement of the abstracts is as follows: 1.—AGRICULTURE AND HORTICULTURE. 2.—FOOD; also appropriate Microbiological Processes; Essential Oils. 3.—SANITATION, including Water; Sewage; Atmospheric Pollution, etc. 4.—APPARATUS AND UNCLASSIFIED.

INDEX OF AUTHORS' NAMES

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JOURNAL OF THE SCIENCE OF FOOD AND AGRICULTURE

ABSTRACTS

OCTOBER, 1956

I.—AGRICULTURE AND HORTICULTURE

General : Soils and Fertilisers

Soil Survey : Tunica Co., Mississippi. T. Fowlkes, C. G. Morgan, J. A. Herren, D. D. Mason, L. A. Davidson and I. L. Martin (*U.S. Dep. Agric., Soil Conserv. Service*, 1956, Series 1042, No. 14, 86 pp. and 6 maps). H. S. R.

Soil survey reports. II. Part of West Singapore Island. W. P. Panton (*Malayan agric. J.*, 1955, **38,** 2—26).—Characteristics of the 17 soil series identified are given. A. H. CORNFIELD.

Agricultural potential of the Central Queensland Highlands. J. Hart (*Qd agric. J.*, 1955, **81,** 187—201).—The climate and soils of the region are described and results obtained with typical crops presented. The future agricultural pattern of the region is discussed. A. H. CORNFIELD.

Willcox's agrobiology. IV. Review of Willcox's reply. C. A. Black, O. Kempthorne and W. C. White (*Agron. J.*, 1955, **47,** 497—498).—Willcox's reply to earlier criticisms (*Agron. J.*, 1954, **46,** 315, 320, 323, 326) of his " Quantitative Agrobiology " is discussed and further criticisms made. A. H. CORNFIELD.

Quantitative agrobiology. V. Further comments on Black, Kempthorne and White's criticism of " Willcox's Agrobiology ". O. W. Willcox (*Agron. J.*, 1955, **47,** 499—502).—A reply. See previous abstract. A. H. CORNFIELD.

Structure in forest soils. Accumulation of humus under forest. A. F. Tyulin (*Pochvovedenie*, 1955, No. 1, 33—44).—In these soils Fe humate aggregates (Group II) contain more humus, N and P than do Ca humate aggregates (Group I). The E_h of the upper soil layer is >350 mv. Under some conditions E_h may fall to 260 mv. when Group II aggregates break up and Group I aggregates are formed from them. Ploughing the soil diminished the proportion of Group II aggregates, increased E_h, lowered the humus content and diminished the stability of Group I aggregates.
SOILS & FERT. (A. G. P.).

Calibration and field use of the neutron-scattering method of measuring soil water content. J. W. Holmes (*Aust. J. appl. Sci.*, 1956, **7,** 45—58).—The measurement of soil water content by neutron scattering is considered theoretically and mathematically and a field technique described in detail. A series of measurements made *in situ* is reported and evaporation from the land surface calculated from the results. (17 references.) J. S. C.

New method of infiltration of the soil with water. Anon. (*Agric. Newsletter, Neth.*, 1956, 8—10).—Water is supplied from tanks through a distributing system of pipes to drill coulters through which it is injected into the soil at intervals of 20 cm. and depths of ~10 cm. The drills are drawn along the soil by tractor. Losses of water by evaporation are minimised by this technique. J. S. C.

Determination of soil moisture with a " V.2.A Stahl-Plexiglass " electrode. H. Buschman (*Z. PflErnähr. Düng.*, 1956, **72,** 239—248).—The electrode assembly consists of two semi-conical steel probes 30 mm. long. These are inserted into two Plexiglass rods held together by a Plexiglas spacing. There is a constant relationship between log soil moisture (x) and log resistance between electrodes (y), given by $y = ax + b$ where a and b are constants for any one soil. This relationship holds for fertilised soils, as long as the fertiliser distribution is even. M. LONG.

Measurement of hydraulic conductivity by the auger hole method in anisotropic soil. M. Maasland (*Soil Sci.*, 1956, **81,** 379—388).—In published formulæ for the determination of the hydraulic conductivities by the rise of water in auger holes, soil is assumed to be isotropic. The formulæ are modified to cover the case of anisotropic soils. T. G. MORRIS.

Water conservation with clay core dams. H. B. Wilson (*J. Agric. W. Aust.*, 1955, **4,** 285—292).—The points to be considered when damming a creek to conserve water are suitability of site, availability of suitable clay, and salt content of the water. These points are discussed and details of construction of the dam are described. A. H. CORNFIELD.

Irrigation in Western Australia. Anon. (*J. Agric. W. Aust.*, 1955, **4,** 295—301).—A report on Government-controlled irrigation areas, 1953—54. A. H. CORNFIELD.

Determination of water-stable aggregates in soils. W. T. H. Williamson, J. Pringle and J. R. H. Coutts (*J. Sci. Food Agric.*, 1956, **7,** 265—269).—A rapid and convenient wet-sieving method for the determination of the water-stable aggregates in a soil, giving results reproducible within about 1% is described. Comparison of results obtained, with those of other methods is made. E. M. J.

[A] **Clays and some non-carbonate minerals in limestones and associated soils of Israel.** [B] **Clay mineralogy of the major soil types of Israel.** D. H. Yaalon (*Bull. Res. Counc. Israel*, 1955, **5B,** 161—167, 168—173).—[A] In the three types of limestone studied (*a*) hard, associated with terra rossa, (*b*) soft, producing a rendzinoid soil, and (*c*) marly, giving rise to highly calcareous mountain marl soil, the dissolution of the carbonates was effected by NH_4 acetate–acetic acid solution adjusted to pH 3, and soil clays were obtained by dispersion with Calgon. Routine microscopical examinations were made of all the coarser fractions and some of the minerals were examined by X-ray powder techniques. Clay minerals of limestone-derived soils are inherited from the parent material; weathering produces essentially no alteration of the clay minerals until the carbonates are completely leached out; the nature of the parent material and the properties of its clay minerals exert a dominant influence on the characteristics of the limestone-derived soil in arid and semi-arid climates. (19 references.)

[B] The clay minerals of the major soil types of Israel, studied by X-ray diffraction, include soils containing montmorillonite and illite in various proportions with kaolinite as accessory, others having kaolinite as the dominant clay mineral, and those containing polygorskite and montmorillonite. The clays of the basaltic and red sandy loam (hamra) are believed to be authigenic whereas in other soil types the clay minerals are inherited or structurally derived from the parent material and are likely to have influenced the development and nature of the resulting soils. (11 references.)
E. M. J.

Effects of entrapped air and optically oriented clay on aggregate breakdown and soil consistence. R. Brewer and A. V. Blackmore (*Aust. J. appl. Sci.*, 1956, **7,** 59—68).—Four fine-textured soil materials, of a range of consistencies as described by B. E. Butler (J.S.F.A. Abstr., 1956, ii, 42) were tested physically and studied in thin section. The effect of entrapped air on the breakdown of soil aggregates in these soils is generally small. The pattern of oriented clay coatings may cause rapid breakdown of the natural aggregates into smaller water-stable aggregates by expansion on wetting. (11 references.) J. S. C.

Influence of organic matter on differential thermal analysis of clays. L. Silfverberg (*Roy. Swed. geotech. Inst. Proc.*, 1955, No. 11, 36 pp.).—A report of laboratory work describes the equipment evolved and discusses standard curves and the influence on them of org. matter. Graphs showing thermal and chemical pretreatment effects on various samples are given and the results are discussed. Different forms of org. material give characteristic peaks in differential thermal analysis curves. The method should provide a tool for further research on humus. RD ABSTR. (R. B. C.).

Clay minerals of South African soil groups. IV. Soils of the temperate regions. C. R. van der Merwe and H. Heystek (*Soil Sci.*, 1956, **81,** 399—414).—X-Ray diffraction and differential thermal analyses of clays of podsolic and brown forest soil groups are reported. T. G. MORRIS.

Pretreatment of soils for mechanical analysis by an elutriation method. II. I. Kataoka, G. Yoshikawa and T. Kitamura (*J. Sci. Soil Tokyo*, 1954, **25,** 102—106).—Aq. oxalic acid (5%) and oxalic acid–Na_2S are recommended for removing Fe and Al oxides prior to mechanical analysis of soils. SOILS & FERT. (A. G. P.).

Distribution of atmospheric moisture in the microclimate above a grass sod. V. G. Sprague (*Agron. J.*, 1955, **47,** 551—555).—Atm. moisture and temp. were determined from April to Oct. over three years at heights ranging from 1·5 to 60 in. above a grass sod. The average moisture content of the air for each month decreased progressively with height. Near the ground the moisture content of the air was greatest at noon or soon thereafter and was consistently greater during the day than during the night. At 60 in. the variation during the day was small. The air contained more water on cloudy than on clear days. V.p. deficits (difference between the saturation v.p. at the observed air and dewpoint temp.) increased from April to July and then decreased to Oct. and also increased

with height. The R.H. was greater near ground level than above during both max. and min. air temps. A. H. CORNFIELD.

Soils of the Nanakhi series, East Pakistan. II. Chemical investigation and classification. A. Karim and D. H. Khan (*Soil Sci.*, 1956, **81**, 389—398).—Chemical analyses of the soil and clay fractions are reported. The soils are classified as grey-brown podsolic. T. G. MORRIS.

Titration of clay minerals. J. R. Goates, K. H. Anderson and C. P. Willis (*Soil Sci.*, 1956, **81**, 371—378).—Clay particles (80—100 mμ.) after electrodialysis or saturation with H^+ were suspended in CO_2-free water and incubated with varying amounts of standard NaOH or KOH. After equilibration, the Na^+, K^+ and H^+ activities were determined. Results obtained were in general agreement with those of other workers. Eight different reactions considered to play a part in the equilibration of electrodialysed clays are discussed. In the case of H^+-saturated clays there are only four reactions. T. G. MORRIS.

Adsorption of dyestuffs on soil minerals. H. Peter and S. Markert (*Z. PflErnähr. Düng.*, 1956, **73**, 11—25).—There is no fundamental difference in the behaviour of org. dyestuffs (notably methylene blue) towards metal ions of the first and second groups of the Periodic System, with regard to adsorption and ion exchange both on the surface and in the lattice layers of soil minerals. The amount of dyestuff adsorbed is almost linearly related to Riehm's " T-Wert." The determination of adsorption thus depends on a spectrophotometric measurement of colour intensity of the dye after shaking with soil. M. LONG.

Elimination of clogging in direct determination of soil exchangeable cations by the Beckman flame spectrophotometer. L. Choiniere (*Soil Sci.*, 1956, **81**, 422).—Clogging of the burner orifice by deposited carbon can be prevented by diluting the NH_4 acetate extract with its own vol. of Dmitrieff–Kokline alcoholic solution. (Redistilled water containing 10% of ethyl alcohol and 0·5% of triethanolamine.) T. G. MORRIS.

Determination of exchangeable calcium in soils containing calcium carbonate. S. K. Tobia and N. E. Milad (*J. Sci. Food Agric.*, 1956, **7**, 314—319).—Methods for the determination of exchangeable Ca in soil are critically reviewed, viz., (*a*) methods based on exhaustive leaching, (*b*) pptn. methods. A 0·2N-KCl solution brought previously into equilibrium with $CaCO_3$ permitted almost complete displacement of adsorbed Ca (error <3·5%). E. M. J.

Balance of nitrogen in intensive cultivation. Cl. Tendille and G. Barbier (*C. R. Acad. Agric. Fr.*, 1956, **42**, 236—240).—Gains and losses of N during intensive cultivation mainly on arable farms, but also on those carrying stock are considered quantitatively. The need to replenish N supplies used in crop growth (particularly org. N) and that lost by drainage, the value of org. residues in maintaining a satisfactory level of org. N in soils and in producing a favourable granular condition are discussed. E. M. J.

Determination of surface area of dicalcium phosphate by isotope exchange. J. H. Caro and W. L. Hill (*J. agric. Food Chem.*, 1956, **4**, 436—438).—A technique based on the radioactive isotope exchange principle is used in determination of the surface area of routine prep. of dicalcium and basic phosphates. Determination of solution activity and concentration as the test sample reacts with a reagent solution containing the isotopes provides a measure of exchangeable P. This is compared with the P surface density, found by calibration of standard samples by gas absorption measurements, to yield a measure of total surface area. E. M. J.

Cause of high phosphate availability in soils. F. Scheffer, A. Kloke and H. von Sperling (*Z. PflErnähr. Düng.*, 1956, **72**, 200—214).—The high lactate-solubility of the phosphate in certain soils in the Gottingen–Northeim district is due, probably, to human factors as well as geological causes. Availability is closely related to the chalk content of the soil, being optimal with 1—2% of $CaCO_3$ depending on the rate of solution of the chalk. Neither Fe or Al sesquioxides nor org. P are influential factors and the available P is probably in the form of a Ca phosphate. M. LONG.

Effect of adding vinyl acetate–maleic acid copolymer to soil upon uptake of phosphorus by oats and utilisation of fertiliser phosphorus. P. N. Carpenter and R. A. Struchtemeyer (*Agron. J.*, 1955, **47**, 530—531).—Application of the copolymer mentioned (2000 lb. per acre) to a silty clay in pot tests improved soil aggregation and reduced the % of P in oats and the utilisation of the P of applied superphosphate. A. H. CORNFIELD.

Chemical soil analysis with special reference to the lactate method. H. Egnér (*Landw. Forsch. Sonderh.*, 1955, **6**, 28—32).—An acetic acid–NH_4 lactate extractant for extracting available K and P from soil is recommended. Determinations are made colorimetrically or by flame photometer. SOILS & FERT. (A. G. P.).

Measurement of forms of soil magnesium and soil magnesium requirement. B. B. Tucker (*Dissert. Abstr.*, 1956, **16**, 205—206).—Investigation showed that of current procedures for the analytical determination of Mg, the most satisfactory was titration with ethylenediaminetetra-acetic acid after removal of Ca preferably as Ca tungstate rather than as sulphate or oxalate. The extraction of Mg from soil samples by various extractants was studied. The effects of the Ca : Mg ratio in the soil on soya-beans are described. O. M. WHITTON.

Strontium and barium in plants and soils. H. J. M. Bowen and J. A. Dymond (*A.E.R.E./Spar/4*, 1955, 13 pp.).—A method for the determination of Sr and Ba in plants and soil extracts is described, using the technique of activation analysis. Nine English soils (including two rich in Sr) and the plants growing on them were studied. The effect of the pH of the soil extractant on the availability of these elements varied widely with the soil type. Sr was preferentially absorbed (with respect to Ca) by plants from most of the soils, while Ba was taken up much less readily. Native plants may contain concn. of Sr of up to 2·6% of dry wt. when growing on Sr-rich soils: possible Sr indicator and accumulator plants are discussed. E. M. J.

Flame photometric determination of barium in Mehlich's method of determining soil exchange capacity. D. Schroeder (*Z. PflErnähr. Düng.*, 1956, **73**, 86—87).—Mehlich's procedure for the estimation of base-exchange capacity in soils involves the determination of Ba. In place of the usual gravimetric or colorimetric methods a flame photometric estimation is proposed. With a hydrogen flame neither the $MgCl_2$ of the extractant solution nor Ca from the soil cause interference at 873 mμ., but both do so with an acetylene flame. M. LONG.

The manganese status of Schleswig-Holstein soils in relation to the weather. E. Kosegarten (*Z. PflErnähr. Düng.*, 1956, **73**, 25—39).—The active (exchangeable and readily reduced) Mn content of a soil may vary with alternating wet and dry spells. Exchangeable Mn increases soon after rainfall, while readily reducible Mn decreases. During dry and prolonged wet periods the fractions behave in the opposite manner. Humus content, pH and soil type, amongst other factors, influence these variations. Data for seven soils are discussed in connexion with the availability of Mn to plants and with the estimation of plant requirements. M. LONG.

The non-available forms of manganese in soils. A. Finck (*Z. PflErnähr. Düng.*, 1956, **73**, 59—73).—Hydrated oxides of Mn in podsols are largely in hard concretions, whilst in brown earths they are predominantly in finely divided forms. Large amounts of Mn as carbonate exist only in soils of high chalk content. M. LONG.

Cobalt content of some Danish soils. P. Schambye and I. Jacobsen (*K. Vet-Højsk. Aarsskr.*, 1955, 53—77).—Data are presented for 12 profiles of sandy soils of Jutland on which Co deficiency in cattle occurred. The Co content of the soils was greatest in podsols having a hard-pan layer (values diminished below the pan) and in general ranged from 3·04 to 5·66 p.p.m. at 0·25 cm. depth and from 0·96 to 4·00 p.p.m. at 25—40 cm., ranges being lower generally than those in other countries. No relationship was apparent between the Co content of soils and that of crops growing in them. SOILS & FERT. (A. G. P.).

Symptoms of cobalt deficiency in the Black Forest and its control. H. Riehm (*Landw. Forsch. Sonderh.*, 1955, **6**, 139—144).—Co deficiency occurs mainly in granite (average Co content 0·8 p.p.m.) regions, but never in gneiss (Co, 9 p.p.m.) regions. Cattle show symptoms of deficiency when the Co content of soil and hay was 0·2—2·2 p.p.m.). Basic slag (itself containing Co) promotes the growth of legumes which contain more Co than do grasses. Direct feeding of Co salts to cattle is more economical than pasture treatment. SOILS & FERT. (A. G. P.).

Copper and zinc exchange from dilute neutral solutions by soil colloidal electrolytes. L. E. DeMumbrum and M. L. Jackson (*Soil Sci.*, 1956, **81**, 353—357).—Slightly sol. salts or oxides of Cu and Zn were placed in Cellophane dialysis bags and suspended in either CO_2-free distilled water or 0·5N-Ca acetate. A colloidal electrolyte (Ca montmorillonate or Ca peat) was placed in a similar bag and also suspended on the medium. After 2—3 months at room temp. or 2—3 weeks at steam heat, the amounts of Cu or Zn adsorbed by the electrolytes were determined. Considerable amounts of Cu and Zn were exchanged, especially at high temp. At higher temp. the amounts of Cu and Zn absorbed were similar, regardless of cation source and of presence of excess Ca in the supporting medium. An increment of exchange capacity, specific to Cu and Zn, is postulated. T. G. MORRIS.

Immobilisation of boron by inorganic soil constituents. H. Scharrer, H. Kühn and J. Lüttmer (*Z. PflErnähr. Düng.*, 1956, **73**, 40—48).—Sesquioxides of Fe and Al, especially the latter, and clay

minerals were capable of immobilising large amounts of B. No immobilisation of HBO_3 by silicic and humic acids could be detected. Immobilisation of B is due either to complex formation involving H_3BO_3 or to adsorption of the borate ion by OH-groups of the sesquioxides or clay minerals. Soil pH is an important factor, max. immobilisation occurring between 5·5 and 7·0 with Fe sesquioxide and between 8·0 and 9·0 with clay minerals. This explains the varying behaviour of soils after liming. Boron immobilisation is also dependent on the accessibility of the reactive OH-group in the soil mineral and is thus influenced by grain size. M. LONG.

Relation between v. Post's "Humositatsgrad," Keppeler's "Vertorfungsgrad" and the specific gravity of high moor peats. H. Segeberg (*Z. PflErnähr. Düng.*, 1956, **73**, 74—85).—The connexion between v. Post's 'Humositatsgrad," Keppeler's "Vertorfungsgrad" and sp. gr. was established statistically. Using a table, it is possible to estimate agriculturally important characteristics of a peat from its "Humositatsgrad" and dry vol.-wt. The layer densities of these peats can be estimated, thus simplifying the prediction of subsidence. The sp. gr. and hydrolysis of several peat-forming mosses by 72% H_2SO_4 were investigated with particular regard to the evaluation of Keppeler's "Vertorfungsgrad" estimation. M. LONG.

Rate of decomposition of organic matter in various soils. H. Koeff (*Z. PflErnähr. Düng.*, 1956, **73**, 48—59).—The rate of decomposition of various org. materials was followed by measurement of carbon dioxide evolution. In a poor acid soil the rate depended on the C/N ratio of the material applied, whilst on a loam decomposition was nearly independent of the N content. Decomposition experiments with numerous soils using wheat straw and lucerne showed that the connexion between the decomposition of N-free and that of N-rich org. matter is a characteristic of each soil. pH is also an important factor. Soils which evolve much CO_2 without the addition of org. matter, decompose added matter quickest, regardless of the N content of the matter added. No correlation was found between NH_3[concn., saccharase content or acetate-sol. nutrients and decomposition rates. M. LONG.

Absorption-photometric changes in humus during root decomposition. II. Changes in coloured components of two humus fractions during the humification of lucerne roots. H. E. Freitag (*Z. PflErnähr. Düng.*, 1956, **72**, 231—239).—Changes in colour adsorption by the fulvic and raw humus fractions of humus during the decomposition of the root material are determined and expressed numerically as the slope of an almost linear curve. The data provides information on the rate and course of the humification process. M. LONG.

Identification and estimation of soil inositol phosphates. G. Anderson (*J. Sci. Food Agric.*, 1956, **7**, 437—444).—A paper chromatographic separation in one or two dimensions and development with methanol/aq. NH_3 is described, whereby inositol mono-, di-, tri-, tetra-, and hexa-phosphates are resolved into four spots, the tri- and tetra-phosphate moving together; or, using acid solvents, e.g., acetone/acetic acid, all these compounds move in a compact group, in the determination of inositol phosphates in soils. The inositol phosphates were extracted with NaOH and after removal of org. and inorg. impurities were precipitated as the Ba salts and converted into the free acids or Na salts. Inositol hexaphosphate made up ~⅓ of the total soil org. phosphate; the tetra- and/or triphosphates ~2 or 3% and no other inositol phosphate was found. (17 references.) E. M. J.

Dehydrogenase activity of a soil as a measure of biological activity. G. Lenard (*Z. PflErnähr. Düng.*, 1956, **73**, 1—11).—The dehydrogenase produced by soil micro-organisms reacts with triphenyltetrazolium salts to form the red triphenylformazan. The intensity of the red coloration produced in a methanol extract of soil after the addition of triphenyltetrazolium chloride is proportional to the biological production of triphenylformazan in the extract. This affords a colorimetric method for expressing the dehydrogenase activity of the soil. M. LONG.

Soil studies using sweet vernal grass to assess element availability. I. Preliminary investigations. II. Molybdate ion fixation in New Zealand soils. N. Wells (*N.Z. J. Sci. Tech.*, 1956, **37, B**, 473—482, 482—502).—I. Sweet vernal grass (*Anthoxanthum odoratum*, L.) was used as an indicator of element availability in soil and a comprehensive scheme of analysis, using spectrographic techniques, is formulated. Extreme values found in growth and composition of sweet vernal grass for 14 elements from 250 soils are tabulated. (16 references.)

II. The Mo content of sweet vernal grass is controlled by the availability of Mo in the topsoil rather than the total amount present. Unavailability is due to fixation of the Mo ion by Fe compounds released during soil weathering. Replacement of retained molybdate by another anion, or removal of Fe from the topsoil, releases Mo to the plant. (22 references.) J. S. C.

Mineral nutrients in native vegetation on Atlantic Coastal Plain soil types. V. A. Lazar and K. C. Beeson (*J. agric. Food Chem.*, 1956, **4**, 439—444).—An intensive study over a period of two years of the concn. of Co, Cu, Mn, Ca, P in vegetation (native browse and forage species) on five soil types in six areas of the Atlantic Coastal Plain indicated that sampling leaves of the swamp blackgum (*Nyssa sylvatica*, Marsh. var. *biflora* (Walt.) was an efficient method of estimating the mineral status (except Ca) of native forage species. Two samples of blackgum leaves were adequate for grouping soils with respect to Co and Cu; the Co content of the soil was not a sufficiently sensitive estimation of that in the plant to permit it to be used to estimate the Co concentration in the vegetation. (12 references.) E. M. J.

Depth of ploughing of chernozems under winter crops in the Ukraine. M. T. Federovskii (*Pochvovedenie*, 1955, No. 1, 16—31).—Deep ploughing which buried the surface soil or mixed surface and sub-surface layers lowered the yield of winter wheat. Loosening without turning the soil to a depth of 40 cm. resulted in smaller yields than did loosening to 20 cm. Ploughing should aim to bury stubble and move the fertile surface layer to a depth at which root development of the subsequent crop is most intense. SOILS & FERT. (A. G. P.)

Rôle of winter rye and a vetch-oats mixture in cultivating sod-podsolic soils. F. I. Levin (*Pochvovedenie*, 1955, No. 2, 42—47).—Soil in the row under the plants showed a more water-stable structure, lower acidity and contents of available Fe and Al and a higher total exchangeable base content than did that between the rows. SOILS & FERT. (A. G. P.).

Some effects of burning on forest soils of western Oregon and Washington. R. C. Austin and D. H. Basinger (*J. For.*, 1955, **53**, 275—280).—Burning logging slash lowered the moisture-holding capacity of the upper 0·5 in. of soil, and the total N and org. matter contents. P, K, Ca and Mg were released in sol. and available forms over approx. two years. The pH was raised from 4·5 to 7·6 but fell to 5·7 after two years. Effects of burning are limited to the upper 2 in. of soil and are usually concentrated in the top 0·5—1·0 in. SOILS & FERT. (A. G. P.).

Causes of soil fatigue in fruit-tree nurseries. H. Fastabend (*Landw.-angew. Wissensch. Sonderh. Gartenbau*, 1955, **4**, 95 pp.).—Symptoms of soil fatigue (poor development of fruits) were removed by leaching the soil heavily with water; they were induced artificially by returning the leachates or by addition of root material of apple (but not that of other roots). Mulching stimulated root production in the upper layer of soil and delayed the symptoms of soil fatigue. The latter is probably caused by toxic excretions of roots, removable by water or inactivated by heating but resistant to microbial decomposition. SOILS & FERT. (A. G. P.).

Portable power-driven soil sampler. E. R. Ferguson, R. M. Voigtel and J. L. Smith (*Soil Sci.*, 1956, **81**, 419—421).—A pack mounted, 2·5 horse-power petrol engine drives, through a flexible coupling, an auger 2·5 in. in diameter and (with extensions) 42 in. long. Three types of auger are described. The time of sampling is reduced. Samples can be taken under conditions that preclude the use of the conventional hand tool. T. G. MORRIS.

Temperature and moisture relationships in the granulation of fertilisers. R. C. Smith (*Agric. Chemicals*, 1956, **11**, No. 2, 34—36, 121—123).—The effects of temp. and moisture content on granulation, particularly where ammoniation is practised, are described. A. H. CORNFIELD.

Nitrogen in commercial glasshouse practice. O. Owen (*J. Sci. Food Agric.*, 1956, **7**, 301—304).—The application of N-fertiliser to crops and in intensive horticulture is reviewed, the most important considerations being the timing of the dressings and the amounts of the materials actually used each time, e.g., with rapidly developed crops, cucumbers or tomatoes. E. M. J.

Nitrogen solutions as fertilisers. H. R. Lathrope (*Agric. Chemicals*, 1956, **11**, No. 3, 51—52). A. H. CORNFIELD.

Permanence of nitrogen in liquid manure. Y. Kauko (*Medd. finska Kemistsamf.*, 1955, **64**, 85—104).—The physico-chemical relationships between the constituents of liquid manure are considered theoretically and demonstrated by laboratory experiments. The pH of the unmodified liquid depends on the relative concn. of bicarbonates and free CO_2. The escape of CO_2 (causing a rise in pH) can be partly prevented by a covering oil-film; practically the whole of the NH_3 (formed by decomposition of the urea) is retained by the film, but its escape cannot be prevented when the liquid is spread on the land. Conservation of the urea can be achieved by keeping the pH $<6·5$ by the addition of Ca^{++} [as $Ca(NO_3)_2$] or HCl in quantities requisite for the decomposition of the bicarbonates.

Increases in pH due to the escape of CO_2 can be prevented by maintaining a suitable concn. of CO_2 in the space above the liquid. Under these circumstances, the urea can be conserved during <7 months. P. S. ARUP.

Condensation products of urea and formaldehyde as sources of nitrogen for plant growth. K. Schmalfuss and G. Michael (*Z. PflErnähr. Düng.*, 1956, **72**, 193—200).—Condensation products of urea and formaldehyde (Ureaform), having mol. ratio >1 mineralise slowly in the soil. The recovery of N as NO_3' in an incubation test with a neutral sandy loam was 95% and 84% respectively for unwashed and washed (to remove urea) Ureaform. Utilisation of nitrogen in pot tests with oats followed by mustard was about 40%. M. LONG.

Production of superphosphates and plans for increasing output. D. L. Tsȳrlin (*Zh. prikl. Khim.*, 1955, **28**, 1025—1036).—Methods for increasing and improving output by complete mechanisation of the industry are discussed. By (*a*) accelerating the decomposition process, (*b*) improving mixing and loading methods and (*c*) minimising waste by better storage facilities, it is envisaged that overhead costs can be halved. A higher degree of fluorine recovery is demanded and greater economy in the use of acids and salts in various stages of production. Detailed diagrams of apparatus necessary for carrying out these improvements by continuous mechanised production methods are given, including apparatus for mixing, measuring and final processing. Analysis charts show ratio of improved production by these methods. A. L. B.

Crop response to high-alumina nitric phosphate fertilisers. J. D. DeMent and L. F. Seatz (*J. agric. Food Chem.*, 1956, **4**, 432—435).—High-alumina nitrated phosphate fertilisers were satisfactory sources of P for cotton, small grain or maize, but were less effective than concentrated superphosphate as a source of starter fertiliser for maize and during the early growth of plants. Yields of wheat grown for forage from plots fertilised with the low-water-sol. high-alumina nitrated phosphates were 87% of those obtained from concentrated superphosphate. E. M. J.

Action of granulated phosphates on soil microflora. G. Farkasdi (*Z. PflErnähr. Düng.*, 1956, **72**, 248—254).—The action of granulated mineral and organo-mineral (Biosuper) superphosphates on the microflora of a moderately acid sandy soil and a neutral black soil was examined. Both fertilisers intensify reproduction of bacteria, Biosuper increasing the bacterial count of *Azotobacter* from 50 to 100 thousandfold. The effective radius of action of one granule extends only a few centimetres, the effect being min. in the granule in the case of superphosphate, but at a max. in the case of Biosuper. At first there is little difference in the action of the two fertilisers, but after four months Biosuper produces the stronger stimulation of all species of bacteria, but not of fungi. In an acid sandy soil the stimulation of microflora was greater than in the neutral black soil in the case of both phosphates. M. LONG.

Slowly soluble source of micronutrients for plants. W. A. Rhoads, A. Wallace and E. M. Romney (*Soil Sci.*, 1956, **81**, 359—369).—Bean plants were grown in a calcareous soil which had been treated with fritted trace elements (FTE, a glassy, very slowly sol. frit containing silicates of micronutrients, e.g., Fe and Mn) at rates up to 10^5 lb. per acre. After four weeks growth yields were not increased by the FTE treatments; the highest rate appeared to be toxic although none of the micronutrients Fe, Mn or Zn was present in the plant in toxic amounts. In a second test FTE materials labelled with ^{59}Fe were used on three soils (acid, neutral and alkaline sandy loams). There was no appreciable uptake of Fe from the FTE. T. G. MORRIS.

Green manuring in orchards in the granite belt. M. A. Hannigan (*Qd agric. J.*, 1955, **81**, 269—272).—The principal green manure crops, which are best grown in the winter in this area, for granitic orchard soils, which are very low in org. matter, are New Zealand blue lupin, golden tares, and black winter rye. Cultural methods and fertiliser requirements of the green manures are described. A. H. CORNFIELD.

Liming sod-podsolic soils to increase the effectiveness of dung. O. K. Kedrov-Zikhman and A. I. Baeva (*Pochvovedenie*, 1955, No. 1, 25—32).—Simultaneous application of lime and dung was as effective as the use of double the amount of dung without lime. Available Al in the soil diminished. SOILS & FERT. (A. G. P.).

Plant Physiology, Nutrition and Biochemistry

Ion absorption by maize roots as influenced by moisture and aëration conditions. R. E. Danielson (*Dissert. Abstr.*, 1956, **16**, 201).—The investigation reported showed that the intake of Rb ions by young maize seedlings is influenced by O_2 concn. below a certain critical level. The critical O_2 level is directly related to the moisture content of the culture medium and is independent of the osmotic pressure; the magnitude of the effect of O_2 decreases with increasing soil moisture tension. The Rb uptake is scarcely influenced by the osmotic pressure of the culture solution. Large decreases in the degree of root and shoot hydration at high moisture stress do not limit Rb intake by young maize seedlings. O. M. WHITTON.

Moisture deficits in relation to growth and development of Red Mexican beans, *Phaseolus vulgaris*. J. S. Robins and C. E. Domingo (*Agron. J.*, 1956, **48**, 67—70).—Yields of beans were reduced by ~20% when plants were under visible moisture stress for 15 days before blooming, for 18—22 days during blooming, or for 15 days prior to ripening of the first pods. Yields were not reduced by a five-day moisture stress period prior to ripening. Plant development was retarded by moisture deficits before blooming and hastened by deficits during blooming or maturation. Irrigation increased yields only when visible moisture stress occurred. A. H. CORNFIELD.

Effect of molybdenum deficiency and mineral toxicities on crops in acid soils. W. Plant (*J. hort. Sci.*, 1956, **31**, 163—176).—Cauliflowers, other brassicas and lettuce have been grown for several years on three acid soils treated with limestone, dolomite and gypsum with Na molybdate as seed dressing. On one site, on which cauliflowers and lettuce were grown in rotation, gradual fall in pH was reflected in the yields, visual symptoms of Mo deficiency and leaf analyses. Whiptail was severe where the pH had been lowered by $CaSO_4$ treatment. Treatment of soil with Mo gave good crop response, but liming was more effective. Low levels of Mo in the leaves with accumulation of NO_3' and low ascorbic acid levels were associated with whiptail. Other brassicas at all the sites showed the effects of low soil pH and cropping history. On the least acid soil an Mo deficiency curable by Na molybdate treatment was found. On a medium acid soil there was both Mo deficiency and Mn toxicity and lime was needed to give good crops. On a very acid soil (pH 4·0) in addition, Al toxicity appeared. This responded to limestone or dolomite treatment. On the least and most acid soils, both derived from old red sandstone, $CaSO_4$ reduced Mn uptake, increased Mo uptake and corrected Mo deficiency. On the medium acid soil derived from lower greensand $CaSO_4$ greatly increased Mn uptake and exaggerated Mo deficiency. Lettuce is susceptible to Mo deficiency and behaves similarly to cauliflower. T. G. MORRIS.

Calcium-saturation capacity of vine grafts and resistance to chalky chlorosis. D. Blanc-Aicard and G. Drouineau (*C. R. Acad. Sci., Paris*, 1955, **241**, 1614—1616).—Resistance to chalky chlorosis and the capacity of the root for saturation with $Ca^{\cdot\cdot}$, in grafts of vine species and hybrids were linearly related. J. S. C.

Development of free amino-acids in haricot (*Phaseolus vulgaris*) seeds in course of germination. P. Boulanger, J. Claveau and G. Biserte (*C. R. Acad. Sci., Paris*, 1955, **241**, 577—579).—Two-dimensional paper chromatography of the amino-acids of haricot seed, during germination in the absence of N assimilation, and prior to chlorophyll assimilation, shows that pipecolic acid and arginine constitute more than two-thirds of the total free amino-acid "reserve" in the seed. Detailed results showing the concn. of these and other amino-acids, and of asparagine in various portions of the seed before and after germination, are tabulated. J. S. C.

Amylolytic activity of seeds of *Canavalia ensiformis* under particular experimental conditions. V. Comparison of the activity over a period of time with that of malt amylase. T. de Leo and G. Barone (*Ric. sci.*, 1956, **26**, 131—137).—The enzymic activity of the α-amylase from *Canavalia ensiformis* seeds is superior to that of the α-amylase of malt. The activity-time curves are of similar shape for both types of amylase. L. A. O'NEILL.

X-Irradiation of seeds of *Datura tatula* with special reference to alkaloid production. W. C. Evans and M. J. Menendez (*J. Pharm., Lond.*, 1956, **8**, 277—279).—Of a group of 50 seeds subjected to *X*-rays (5000 r.) only seven seedlings survived. Paper chromatographic studies on these parent plants and on the following generation show that, although distinct morphological differences occur, the nature of the alkaloids present remains unchanged. However, the relative proportions of the individual alkaloids show consistent variation within families in the X_2 offspring. N. M. WALLER.

Effects of Operation Hurricane on plants and soils. R. Scott Russell, H. M. Squire and R. P. Martin (*A.E.R.E./Spar/7*, 1955, 74 + 12 plates + x pp.).—Fall out collected in air-filters by aircraft and on gauze sheets at a site where the γ dose rate was 700 r./hr. at day D + 24 hr. were available for study within two weeks of the trial. Fourteen months later the site of the trial was inspected and soil and plant specimens were collected for laboratory study. The greater part of the early fall-out was sol. in water or dil. salt solutions. Absorption tests on plants indicated that the physical form of fall-out did not affect its biological availability. On day D + 405

little variation in the ratio of isotopes in soil samples occurred; the relation between γ dose rate and deposition was calculated. The extent of penetration into soil was small; 60% remained in the upper inch. The relative injury to plants in three zones is considered in detail. Relative extents of the hazards to grazing animals resulting from metabolic absorption of fission products and from external radiation including, e.g., cows, and the effect on children drinking milk are discussed. E. M. J.

Fission product uptake in plants. E. Glueckauf (*A.E.R.E/Spar/7*, 1955, 2 pp.).—Sp. enrichments of Sr and Cs by comparison with Ca or K respectively can occur only where there is little transpiration and where there is an equilibrium process based on a two-way exchange of fluid and ions, e.g., in parts of a leaf. The largest accumulations of fission products taken from the soil should arise in the parts with much transpiration. Equilibrium exchange processes can be distinguished from kinetic influx of ions. The root substrate takes up fission products by exchange, and this may be accompanied by enrichment, while the root and plant fluid and the bulk of the plant derive their ionic contents from non-equilibrium transport processes. E. M. J.

Micro-method for determining the nicotine group of alkaloids in tobacco plants. B. C. Bose, H. N. De and I. H. Dalal (*J. Indian chem. Soc.*, 1956, **33**, 131—134).—A micro-method, based on the CNBr and aniline colour reaction, is developed for determining nicotine and other pyridine alkaloids in the distillate of tobacco leaves. Nicotine (2 μg. per c.c.) can be estimated easily using a photo-electric colorimeter. A minimum distillate of 300 c.c. must be collected for the complete recovery of nicotine from a small quantity of leaves, etc. I. Jones.

Plant growth substances. ω-Aryl- and ω-aryloxy-alkylcarboxylic acids. K. Gaimster (*J. Sci. Food Agric.*, 1956, **7**, 320—329).—Carboxylic acids of the type $R{\cdot}[CH_2]_n{\cdot}CO_2H$, including the first six or seven members of five homologous series of ω-substituted alkylcarboxylic acids, viz., *o*-methoxyphenoxy-, *p*-chlorophenoxy-, 2 : 4-dichlorophenoxy-, 2 : 4 : 5-trichlorophenoxy- and 1-naphthylalkylcarboxylic acids; and five 1-naphthyl-alkylcarboxylic acids in which the alkyl chain is branched or otherwise modified, were synthesised. In addition to the use of classical methods, for many of the 1-naphthyl acids methods involving the use of org. Cd compounds were employed. Prep. and properties are described. (41 references.) E. M. J.

Non-acidic growth substances in apple leaves. L. E. Powell, jun. (*Dissert. Abstr.*, 1956, **16**, 228—229).—The extraction of non-acidic growth-promoting and growth-inhibiting substances from apple leaves, and their purification and chromatography were studied. The results are presented and discussed. None of the growth substances was identified. O. M. Whitton.

Some fluoro-substituted phenoxyacetic acids. K. H. Klaassens and C. J. Schoot (*Rec. Trav. chim. Pays-Bas*, 1956, **75**, 186—189).—The preparation of 2 : 4-dichloro-6-fluoro- (**I**), m.p. 136°, 2 : 4-dichloro-3-fluoro- (**II**), m.p. 149—150°, and 2 : 4-dichloro-5-fluoro-**phenoxyacetic acid** (**III**), m.p. 148°, is described. **I** and **III** show high growth hormone activity, while **II** is weakly active. C. A. Slater.

Comparative study of action of 2-methyl-4- and -6-chlorophenoxyacetic acids on pieces of Jerusalem artichoke grown *in vitro*. R. Gautheret (*C. R. Acad. Sci., Paris*, 1955, **241**, 1815—1816).—The growth stimulation of Jerusalem artichoke *in vitro* by 2-methyl-6-chlorophenoxyacetic acid was found to be ~1000 times less than that induced by 2-methyl-4-chlorophenoxyacetic acid. No synergistic effects between these two compounds were observed. J. S. C.

Fruit development in relation to plant hormones. III. Auxins in relation to fruit morphogenesis and fruit drop in the blackcurrant *Ribes nigrum*. S. T. C. Wright (*J. hort. Sci.*, 1956, **31**, 196—211).—Auxins and growth inhibitors present in ether extracts of blackcurrant berries were separated, chromatographically. The fruits, contained three auxins (1, 2 and 3) and one growth inhibitor. Auxin 1 was acidic and was identical with indol-3-ylacetic acid (IAA). Auxin 2 was also acidic and probably chemically related to IAA. Auxin 3 was non-acidic and was probably indole-3-acetonitrile. The inhibitor was acidic and somewhat similar to coumarin. Auxin 2 was present in the berries soon after fertilisation, increased in amount to a max. at 42—52 days and then decreased as the berries ripened. Auxins 1 and 3 both showed two maxima, one at 24 days and the other at 42—52 days after fertilisation. Both decreased before harvest; possibly one is the precursor of the other. The inhibitor increased in amount throughout the growth of the fruit, paralleling the increase in dry wt. There was no decrease before harvest. A good positive correlation was established between the max. of auxins 1 and 3 and the rate of increase in vol. of the berries. Auxin 2 was not definitely correlated with growth, it might be a by-product of protein-synthesis. "Running off" or the early drop of berries and the pre-harvest drop were both correlated with low auxin 2 content. T. G. Morris.

Action of maleic hydrazide on the metabolism of sugars by the leaves of tobacco. J. Arnaud, P. Barge, M. Richez and R. J. Gautheret (*C. R. Acad. Agric. Fr.*, 1956, **42**, 168—171).—Maleic hydrazide enhances the metabolism of starch and sol. sugars in the leaves of tobacco especially in the leaves situated on the upper part of the stem, young tissue being more easily affected than older, more completely developed tissue. E. M. J.

Synthesis of some *N*-2 : 4 : 5-trichlorophenoxyacetamido acids. K. S. Bokarev and N. N. Mel'nikov (*Zh. obshch. Khim.*, 1955, **25**, 2493—2496).—2 : 4-Dichlorophenoxyacetamido acids were synthesised by interaction of 2 : 4-dichlorophenoxyacetyl chloride with suitable amino-acids in the presence of alkali or pyridine. These compounds showed various physiological activities when applied to plants but were generally found to stimulate their growth. Synthesis of *N*-2 : 4 : 5-trichlorophenoxyacetamido-acids (by a similar method from 2 : 4 : 5-trichlorophenoxyacetyl chloride) yielded more active compounds. Complete data and classification are tabulated. A. L. B.

Plant growth inhibition and metal complex formation by streptomycin. W. G. Rosen (*Dissert. Abstr.*, 1956, **16**, 221).—The inhibition by streptomycin (**I**) of growth and chlorophyll formation in higher plants was studied. It is suggested that **I** inhibits plant growth by inactivating the cations in the plant cells. O. M. Whitton.

Terramycin and plant growth. A. G. Norman (*Agron. J.*, 1955, **47**, 585—587).—Root elongation of cucumber, flax and maize was reduced by Terramycin (2·5—5·0 p.p.m.) in the nutrient solution. In vermiculite sand, or soil cultures, (10 p.p.m.) Terramycin had no effect on development of maize, oats, barley, or soya-beans. Treatment of seed or plants with Terramycin (10 p.p.m.) had no effect on yields of maize or soya-beans in field trials, although emergence and early vigour of the plants were improved where the plants had been treated. Earlier observations on the apparent growth-stimulating effect of Terramycin are probably accounted for by its protective action through controlling non-specific root pathogens. A. H. Cornfield.

Synthetic growth substances. VIII. Enantiomorphs of α-(1-naphthyl)propionic acid. A. Fredga (*Ark. Kem.*, 1956, **8**, 463—468).—(±)-α-(Naphth-1-yl)propionic acid is prepared by the method of Wedeqvist (*Ark. Kem. Min. Geol.*, 1947, **24B**, No. 14) and has m.p. 148—149°. The acid is separated into the enantiomorphs by crystallisation of the brucine salt from methanol and the cinchonidine salt from acetone-water. As obtained, the rotations of the D- and L- acids were $[\alpha]_D^{25} = +120{\cdot}3°$ and $-120{\cdot}1°$ in absolute ethanol and m.p. of both acids was 69—69·5°. The (−)-acid forms a compound (shown by the m.p. curve) with (+)-hydratropic acid, which is regarded as the pseudo-racemate. The activity of the acid in the pea test is weak and in the S- (flax-root) test is strong with no essential difference between the enantiomorphs. In combination with anti-auxins, however, significant differences are found. E. J. H. Birch.

Optically active auxin antagonists. M. Matell (*Ark. Kem.*, 1956, **9**, 157—162).—The optical resolution of α(-2 : 4 : 6-trichlorophenoxy)propionic acid and (±)α-(2-*iso*propyl-4-chloro-5-methylphenoxy)propionic acid is described. All the isomers show anti-auxin activity but that of the (−) forms is more pronounced. E. J. H. Birch.

Crops and Cropping

Maize investigations at the Ayr Regional Experiment Station. R. J. Norman (*Qd agric. J.*, 1955, **81**, 249—254).—A general account dealing with cultivation required for spring and autumn planting, effects of irrigation, and fertiliser trials. To obtain optimum yields it was often necessary to apply $(NH_4)_2SO_4$ at planting time, when plants were 12—15 in. high and also at the pre-tasselling stage. A. H. Cornfield.

Effects of location, hybrid, fertiliser, and rate of planting on the oil and protein contents of maize grain. C. F. Genter, J. F. Eheart and W. N. Linkous (*Agron. J.*, 1956, **48**, 63—67).—When seven hybrids were grown at 7—8 locations both oil and protein content varied significantly with hybrid and location. The hybrid was more important than location in determining oil content whilst the reverse was true for protein content. The protein content of the grain was higher with 10,000 than with 16,000 plants per acre. The protein content was higher under drought than under good growing conditions and increased with N applications only where plant populations

were high and where moisture was not severely limiting. Application of P and K had no effect on the protein content of the grain. The oil content of the grain was not affected by N, P or K applications or by plant population. A. H. CORNFIELD.

Penyakit merah (red disease) of the padi plant. I. Effect of nitrogen phosphorus, potassium, lime and trace elements on the growth of padi in "Penyakit merah" soils and the uptake of these nutrients in pot tests. J. K. Coulter and R. G. Lockard (*Malayan agric. J.*, 1955, **38**, 151—162).—Marked responses in yields and uptake of P occurred only where P was applied. Little response was made to applications of N, K. dolomitic limestone, or trace elements. The treatments had no consistent effect on the incidence of Penyakit merah. A. H. CORNFIELD.

Dormancy and viability of padi seed. J. Dore (*Malayan agric. J.*, 1955, **38**, 163—173).—The dormancy of freshly-harvested padi ranged from 7 to 11 weeks. Seed retained viability for up to 3·5 years in an air-conditioned room, and for up to two years when sealed in containers with $CaCl_2$. A. H. CORNFIELD.

Breeding varieties of potato resistant to diseases and insect injuries. F. J. Stevenson (*Amer. Potato J.*, 1956, **33**, 37—46).—A general account of the U.S. National Potato-Breeding Programme. A. H. CORNFIELD.

Effect of seeding rates and time of harvest on yield and quality of oat–pea forage. H. J. Hodgson (*Agron. J.*, 1956, **48**, 87—90).—In Alaska, optimum yields of dry matter and protein and the % of dry matter and protein in the forage were obtained with oat–pea seed mixtures containing 50—65% of pea. Yields were not increased by increasing the seeding rate to beyond 100 lb. per acre. Harvesting in late milk to early dough stages was most desirable. A. H. CORNFIELD.

Fodder grasses in Malaya. I. Introduction. II. Application of artificial fertilisers. III. Time and frequency of application of fertilisers. R. Henderson (*Malayan agric. J.*, 1955, **38**, 71—77, 141—150, 250—255).—I. No reductions in yield of Napier, Guatemala or Guinea grasses over four years resulted from either partial or complete replacement of 10 tons of cattle manure per acre per annum by complete inorg. fertilisers at the rate of 3 cwt. per 5 tons of cattle manure. When 12 cwt. of inorg. fertiliser was applied annually yields were increased in all years in comparison with 6 cwt. of inorg. or 10 tons of cattle manure.

II. Yields of Guinea grass were unaffected by application of P but were increased by K and N. An increase of over 2 tons of fresh grass per acre was obtained in the first year of production for every 1 cwt. of mixed $(NH_4)_2SO_4$ and K_2SO_4 applied up to a limit of 7 cwt. of the mixture. Yields continued to increase with applications of up to 6 cwt. of $(NH_4)_2SO_4$ per annum. The residual effect of $(NH_4)_2SO_4$ in the year after application was low.

III. Total annual yields of Guinea grass forage were similar whether the NPK fertiliser was split into 2, 3, 6 or 12 dressings throughout the year. The more frequent applications resulted in a more uniform yield of forage throughout the year. The effect of the fertiliser was confined mainly to the first harvest after application. A. H. CORNFIELD.

Effects of nitrogen fertilisation and rate and method of seeding on grass seed yields in Pennsylvania. R. E. Buller, J. S. Bubar, H. R. Fortmann and H. L. Carnahan (*Agron. J.*, 1955, **47**, 559—563).—Seed yields on a silt loam over two years from four species of grasses as affected by seeding rate, row or broadcast seeding, rate of N application (50—100 lb. per acre) and time of N application (spring, autumn or split) are reported. Seed production was best in the second production year with reed canarygrass, smooth bromegrass and orchardgrass but was best in the first production year with bromegrass. All grasses produced better seed yields when sown in rows than when broadcast. A low sowing rate produced better yields than did twice this rate. With reed canarygrass max. seed production occurred with the heaviest N dressing given in spring. Spring N applications reduced, whilst autumn applications of 50 lb. of N increased, bromegrass seed yields. Lodging occurred when 100 lb. of N was applied per acre. With orchardgrass best seed yields were obtained with 100 lb. of N applied in autumn to broadcast stands. Lodging occurred with spring applications. With timothy max. seed yields occurred with 50 lb. of N applied in autumn. A. H. CORNFIELD.

Competitive relationship of Merion bluegrass as influenced by various mixtures, cutting heights and levels of nitrogen. F. V. Juska, J. Tyson and C. M. Harrison (*Agron. J.*, 1955, **47**, 513—518).—The behaviour of Merion bluegrass in pure culture and in various mixtures with creeping red fescue, redtop and domestic ryegrass with two levels of applied N, two heights of cutting (0·75 in. or 2 in.), and with no cutting under medium fertility conditions was studied. The greatest yield of Merion bluegrass clippings was obtained with the highest level of N and with the 2 in. clipping. Root and rhizome production were inhibited to the greatest extent by high N and the 0·75 in. cutting. In mixed cultures redtop had the most and creeping red fescue the least depressing effect on top growth of the bluegrass. Bluegrass competed favourably with redtop when not more than 10% of redtop, with ryegrass when 50% of ryegrass was used in the seed mixtures, and with creeping red fescue only when high levels of N were applied. Turf of best appearance was obtained with Merion bluegrass grown in pure culture and with a high level of N. A. H. CORNFIELD.

Influence of photoperiod and temperature on growth, flowering and seed production of Dallis grass, *Paspalum dilatatum*, Poir. W. E. Knight (*Agron. J.*, 1955, **47**, 555—559).—Night temp. of 18·3—21·1° and a 14-hr. photoperiod at 21·1—26·5° were the most suitable conditions for greenhouse production of Dallis grass seed. Seed production failed or was erratic with shorter photoperiods or lower night temp. A. H. CORNFIELD.

Lime for pastures in the Gippsland region. R. L. Twentyman (*J. Agric. Victoria*, 1955, **53**, 489—492).—A general account. Very acid soils should be treated with sufficient lime to neutralise most of the acidity, but slightly acid soils need be limed only at seeding. The main benefit of lime has probably been its effect in making Mo more available. A. H. CORNFIELD.

Behaviour of lucerne varieties in the Valley of Mexico. R. E. Buller, J. B. Pitner and M. Ramirez (*Agron. J.*, 1955, **47**, 510—512).—Results obtained over two harvest years with 11 varieties of lucerne of diverse origin and type in the Valley of Mexico (elevation 7600 ft.) are presented. A. H. CORNFIELD.

Pubescence inheritance and leafhopper resistance relationships in lucerne. N. L. Taylor (*Agron. J.*, 1956, **48**, 78—81).—Pubescent lucerne plants (Hairy Arabian) were more resistant to leafhopper infestation than were glabrous plants, although differences in resistance occurred among progenies of glabrous plants, indicating that resistance was inherited. Pubescence was inherited as a quant. characteristic. It is undesirable to use this type of pubescence as a source of leafhopper resistance. A. H. CORNFIELD.

Relationship of varieties and fertilisation to root rots and wilt of lucerne. R. K. Stivers, W. A. Jackson, A. J. Ohlrogge and R. L. Davis (*Agron. J.*, 1956, **48**, 71—73).—Buffalo lucerne in its third year had a higher incidence and severity of crown rot extending into the root than did Grimm or Ranger. Incidence of crown rot and bacterial wilt were not significantly different between the varieties. Incidence of crown rot increased, whilst that of crown rot extending into the root and bacterial wilt tended to decrease, with increasing PK fertilisation. In 4—5-year-old plants, the wilt-susceptible Grimm showed greater severity of bacterial wilt (*Corynebacterium insidiosum*) than did the wilt-resistant Buffalo and Ranger. A. H. CORNFIELD.

Inheritance in *Lespedeza cuneata*, Don. R. P. Bates and P. R. Henson (*Agron. J.*, 1955, **47**, 503—507).—Characters studied in three crosses between individual plants of *L. cuneata* were tannin content, plant height, maturity, flower colour, plant and seed colour, seed size, and % of chasmogamous seed. A. H. CORNFIELD.

Effects of photoperiods on plant growth, flowering, seed production and tannin content of *Lespedeza cuneata*, Don. R. P. Bates (*Agron. J.*, 1955, **47**, 564—567).—Very little vegetative growth of *L. cuneata* occurred with daylengths of <13 hr. The 13-hr. day produced fair growth and resulted in optimum flowering and seed production and was the only treatment which resulted in production of chasmogamous flowers by all strains. Neither chasmogamous nor cleistogamous flowers were produced with daylengths of 14 hr. or longer. The tannin content of the leaves increased with daylength. There were differences due to strain in response to length of photoperiod. A. H. CORNFIELD.

Response of crested wheatgrass and volunteer sweetclover to nitrogen and phosphorus under dryland conditions. R. E. Stitt, J. C. Hide, and E. Frahm (*Agron. J.*, 1955, **47**, 568—572).—Yields of crested wheatgrass (on a clay loam) in a mixed 14-year-old stand with sweetclover increased in the first year with the amount of N applied (25—200 lb. per acre) but were not affected by P (20—80 lb. P_2O_5 per acre). In the following year there was a considerable residual effect from applied N. Yields of sweetclover were increased somewhat by increasing N in the year of application, but were reduced with increasing N in the year following application. Sweetclover yields increased in both years with P applications. Protein (%) in the wheatgrass hay increased with the amount of N applied but was unaffected by P applications. The % of P in the hay was unaffected by N or P applications. A. H. CORNFIELD.

Hygroscopic equilibrium and viability of naturally and artificially dried seed of crimson clover, *Trifolium incarnatum*. H. S. Ward, jun., and J. L. Butt (*Agron. J.*, 1955, **47**, 576—579).—The % germination

of dried crimson clover seed increased with decreasing R.H. (92% to 54%) during storage over four months. Germination was approx. 90% with storage at 54—65% R.H. The no. of hard seed was not affected by storage at R.H. >86%, whilst the no. of hard seed was reduced to nil at 92% R.H. Very similar results were obtained with naturally and artificially (43·3°) dried seeds.
A. H. CORNFIELD.

Seed production and moisture content of ladino clover treated with Endothal. M. A. Massengale and J. T. Medler (*Agron. J.*, 1955, **47**, 528—530).—Spraying ladino clover plants with Endothal (2—6 quarts per acre) had no significant effect on the yield of seed when harvested 1—5 days after treatment. The treatment reduced the % of moisture in the forage in proportion to the amount of Endothal applied.
A. H. CORNFIELD.

Fate of labelled nitrate and ammonium nitrogen when applied to grass and clover grown separately and together. T. W. Walker, A. F. R. Adams and H. D. Orchiston (*Soil Sci.*, 1956, **81**, 339—351).—Ryegrass and clover were grown in pots separately and together on a silty fine sandy subsoil with a low content of N. Labelled N was applied as KNO_3 or $(NH_4)_2SO_4$ and leaching was prevented. The dry matter yield of grass grown separately increased with increasing rates of N, KNO_3 giving the smaller yield. Root yields decreased at high N levels. Final yields of clover grown alone were little affected by additions of N, although in the early stages N had some effect. In the mixed cultures grass yields were almost the same as when grown alone, but clover yields were greatly depressed. The N content of the grass was low even with high applications of N and was similar for both types of N fertiliser and also if grown with clover. The N content of the clover tops, when grown with grass, decreased with increasing applications of N. When grown with clover, grass absorbs all the mineral N available and there is no underground transfer of N from clover to grass. Under the conditions of this test 30% of the labelled N was lost, probably by denitrification, that from KNO_3 being higher. Clover grown alone utilised less labelled N than did grass but with rise in rate of application utilisation and symbiotic fixation decreased. When grown with grass, clover utilised only a small proportion of the labelled N at all levels.
T. G. MORRIS.

Estimates of heritability in hops, *Humulus lupulus*, L. K. R. Keller and S. T. Likens (*Agron. J.*, 1955, **47**, 518—521).—Estimates of heritability of several characteristics were computed using data from each of three replicated clonal propagule trials involving a no. of selected experimental hop lines.
A. H. CORNFIELD.

Production of healthy crucifer seedlings. R. O. Kefford (*J. Agric. Victoria*, 1955, **53**, 494—496).—Chemical and cultural methods for treating seed and seedbeds so as to avoid the production of diseased seedlings are described.
A. H. CORNFIELD.

Mineral nutrition of the oil palm. Chemical composition of the frond in relation to chlorosis and yield. J. K. Coulter and E. A. Rosenquist (*Malayan agric. J.*, 1955, **38**, 214—236).—The extent of yellowing of fronds was negatively correlated with their Mg content, whilst the extent of orange spotting was generally correlated with deficiency of K and excess of Ca in the frond. Yields over the preceding five years were negatively correlated with the extent of orange spotting.
A. H. CORNFIELD.

Determination of cold resistance in the garden chrysanthemum and its relation to winter survival. R. E. Widmer (*Dissert. Abstr.*, 1955, **15**, 2380).—In general, injury to garden chrysanthemums was limited after exposure at −9°, and severe after exposure at −15° for one week. Effects on winter survival of variety, soil moisture content, lengths of the natural hardening period, length of low-temp. exposure, and amount of premature foliage loss are examined. The possible use of the test in breeding hardy garden chrysanthemums is discussed.
O. M. WHITTON.

Pest Control

Use of the entomological literature by the agricultural chemical specialist. F. A. Gunther and L. A. Riehl (*J. agric. Food Chem.*, 1956, **4**, 455—460).—The compilation of world-wide sources of information on entomology, organisation and indexing procedures to facilitate searching and reference to abstracts and indexes, etc., are discussed. (27 references.)
E. M. J.

Fertiliser–pesticide mixtures. H. McVickar (*Agric. Chemicals*, 1956, **11**, No. 1, 41, 100—102).—Some fertiliser–pesticide mixtures are discussed. Health hazards likely to arise in using these materials are indicated.
A. H. CORNFIELD.

Natural predators. Can selective insecticides help to preserve biotic control? B. R. Bartlett (*Agric. Chemicals*, 1956, **11**, No. 2, 42—44, 107—109).—A general discussion.
A. H. CORNFIELD.

Fungicidal activity and chemical constitution. III. Pentachlorophenol derivatives. R. J. W. Byrde and D. Woodcock (*Ann. appl. Biol.*, 1956, **44**, 138—144).—Of nine derivatives of pentachlorophenol (**I**) tested for fungistatic activity against three types of fungi, only the acetyl ester showed an activity approaching that of **I** itself. The fungitoxicity of both the acetyl and propionyl esters decreased as pH increased from 5·4 to 7·5. When sprayed on to tomatoes, apple, and plum at 0·1—0·4% concn., the acetyl ester, although much less toxic than was **I**, caused sufficient damage to preclude its effective use as a foliage fungicide.
A. H. CORNFIELD.

Sampling for the drop size of aerial spray deposits. D. G. Thornton and J. M. Davis (*J. econ. Ent.*, 1956, **49**, 80—83).—The method involved measuring drops on an area on each of a no. of cards placed at regular intervals across the spray swath. Two methods of selecting drops for a mass median diameter determination were used.
A. A. MARSDEN.

Control of forest insects by aircraft. D. A. Isler and J. S. Yuile (*J. econ. Ent.*, 1956, **49**, 92—94).—Recent work on aeroplane spraying with particular reference to evaluation techniques, surveying, operating procedures, the dual spray apparatus, effect of atomisation, nozzle arrangement, and the development of new aircraft specifically designed for agricultural purposes, is reviewed.
A. A. MARSDEN.

Polyvinylpyrrolidine–iodine as an agricultural chemical. Anon. (*Agric. Chemicals*, 1956, **11**, No. 1, 61—62).—Solutions of the chemical (0·1—5·0%) have controlled leaf and root knot nematodes, leaf spot, root rot, and wilt fungi, and centipedes, wireworms, beetles, mealworm larvæ, and red spider mites.
A. A. CORNFIELD.

Differences in arsenic tolerance among the sexes and various stages of the American cockroach. A. J. Forgash (*J. econ. Ent.*, 1956, **49**, 39—43).—Adult male roaches were much more susceptible to As_2O_3 poisoning than were adult females. Last instar nymphs of both sexes showed about equal tolerance and were less susceptible than the adults. Glutathione (GSH) was present in approx. equal concn. in both male and female adults and in rather lower concn. in last-instar nymphs. Cockroaches which had just completed their final moult contained approx. 30% less GSH than did older adults; possible reasons for this deficit are discussed.
A. A. MARSDEN.

Sedimentation method for the determination of the effective particle size distribution of DDT dispersible powders. W. D. E. Thomas (*J. Sci. Food Agric.*, 1956, **7**, 270—276).—A 1% (w/v) suspension of the dispersible powder is allowed to settle and 50-ml. samples are withdrawn 1, 3, 20 and 75 min. respectively after settling has begun. The DDT content of each sample is determined and the data are plotted as % wt. of DDT under size d_s against " equivalent Stokes' diameter " (d_s). (13 references.)
E. M. J.

Distribution and metabolism of DDT injected into the American cockroach. D. G. Cochran (*J. econ. Ent.*, 1956, **49**, 43—49).—DDT injected into the blood stream was found in largest amounts in the alimentary canal, thoracic muscles, fat body and tissues in both sexes. Metabolism of DDT to DDE took place in nearly all tissues. The fat body and its metabolism of DDT to DDE is probably of major importance in explaining the differential susceptibilities to DDT of male and female roaches and their immature stages.
A. A. MARSDEN.

Adsorption of DDT, methoxychlor, and related compounds on the surfaces of insecticide dust diluents and carriers. D. E. Weidhaas *Dissert. Abstr.*, 1956, **16**, 197—198).—The adsorption of DDT, methoxychlor, DDE and its methoxy analogue (methoxy-DDE) and DDA on the surfaces of typical clay-type diluents and carriers is investigated, the adsorption being measured using 95% ethanol or benzene solutions of the insecticides. The extent of adsorption was affected by the nature of the diluent and its pretreatment, the adsorbate and the solvents. Reactions occurred with methoxy-DDE and methoxychlor in some cases and this was correlated with the presence of acid sites on the surface of the diluents.
O. M. WHITTON.

Systemic action of benzene hexachloride in plants: quantitative measurements. F. R. Bradbury and W. O. Whitaker (*J. Sci. Food Agric.*, 1956, **7**, 248—253).—The amount of insecticide absorbed from the saturated vapour by seeds in six weeks varied from 31 μg./g. in wheat to 128 μg./g. in linseed. Wheat seedlings removed up to 100 μg./g. (fresh wt.) of γ-BHC in seven days from an aq. solution in contact with their roots, but there was subsequent loss of the insecticide in the plant. (15 references.)
E. M. J.

Tests of insecticides for control of cucumber beetles in Ohio. F. H. Harries and H. Matsumori (*J. econ. Ent.*, 1956, **49**, 131—133).—Many new insecticides, including chlorinated hydrocarbons and org. P compounds, were very toxic in laboratory tests to both the striped cucumber beetle, *Acalymma vittata*, and the spotted cucumber beetle, *Diabrotica undecimpunctata howardi*. The most effective

materials in field tests were rotenone, lindane, EPN, dieldrin, aldrin, heptachlor, Bulan and DDT. A. A. MARSDEN.

Residues on forage, in the soil, and in milk following pasture treatment with granulated dieldrin. B. A. App, R. H. Carter and R. E. Ely (*J. econ. Ent.*, 1956, **49,** 136—137).—Dieldrin residues on the forage and in the soil of pastures treated with granulated dieldrin at 0·53 or 4·18 lb. per acre are tabulated. Milk from cows grazing during the first 14 days after the application (4·18 lb.) contained dieldrin 0·96 p.p.m.; milk contained 0·21 p.p.m. on pasture receiving 0·53 lb. of dieldrin per acre. Cows excreted dieldrin in the milk for 15—22 days after these pasture applications. A. A. MARSDEN.

Contaminants in radioactive allethrin determined by paper chromatography. F. Acree, jun. and F. H. Babers (*J. econ. Ent.*, 1956, **49,** 135).—The reversed-phase chromatogram of ^{14}C-allethrin using ammoniacal ethanol showed trace quantities of five contaminants, a single one and a mixture of four substances. This mixture contained, amongst other things, both DL-*cis*- and *trans*-2-^{14}C-chrysanthemumic acids, and dimerised allethrolone, possibly formed by hydrolysis of traces of allethrin by the ammonical solvent. A. A. MARSDEN.

Persistence of heptachlor in soils. W. R. Young (*Dissert. Abstr.*, 1956, **16,** 198).—Heptachlor is lost from soil by evaporation and not by leaching or by breaking down into toxic degradation products or metabolites. Heptachlor will not accumulate to harmful levels when used as a soil treatment or foliage spray in controlling insects. O. M. WHITTON.

Spectrophotometric determination of heptachlor and technical chlordane on food and forage crops. E. P. Ordas, Victor C. Smith and Charles F. Meyer (*J. agric. Food Chem.*, 1956, **4,** 444—451).—The Davidow method for determining chlordane (*J. Ass. off. agric. Chem., Wash.*, 1950, **33,** 886) and the Polen-Silverman method for heptachlor (*Analyt. Chem.*, 1952, **24,** 733) were modified by microtechniques to detect toxicant in the 2·5 to 5·0 μg. range. Chromatographic methods (described and illustrated) were developed to separate 2 μg. (or 0·01 p.p.m.) of toxicant with recovery of 80% from 2 kg. of crop material. Good agreement with bioassay methods was obtained. These analytical methods indicated that in crops treated with recommended doses of heptachlor or chlordane there was no significant residue present at harvest time. E. M. J.

Microdetermination of 2-(*p*-*tert*.-butylphenoxy)-1-methylethyl 2-chloroethyl sulphite (Aramite) residues by sulphur dioxide evolution. C. C. Watson (*J. agric. Food Chem.*, 1956, **4,** 452—454).—The production of a red complex by SO_2 with Na nitroprusside in the presence of $ZnSO_4$ and aq. NH_3 is used to detect Aramite residues on fruit; by treating the acaricide with acid, SO_2 is liberated. Aramite can be determined to within 2·5 μg. colorimetrically. 2 μg. of Aramite or 0·38 μg. of SO_2 can be detected by this method. E. M. J.

Systemic action against *Pseudomonas medicaginis* var. *phaseolicola*, of a streptomycin spray applied to dwarf beans. E. J. Napier, D. I. Turner, A. Rhodes and J. P. R. Tootill (*Ann. appl. Biol.*, 1956, **44,** 145—151).—Streptomycin sulphate solution applied to the primary leaves of broad beans exhibited a marked antibacterial action even as far as the fourth trifoliate leaf. This effect lasted for up to 11 days against *P. medicaginis* (halo blight). Mannosidostreptomycin was inferior to streptomycin in systemic action. A. H. CORNFIELD.

Effects of Terramycin and streptomycin, singly and in combination, on the leaf blight disease of maize caused by *Bacterium carotoverum* f. *zeæ*, Sabet. K. A. Sabet (*Ann. appl. Biol.*, 1956, **44,** 152—160).—The growth *in vitro* of *B. carotoverum* f. *zeæ*, Sabet (cause of root and stalk rot and leaf blight of maize) was inhibited by dihydrostreptomycin sulphate and Terramycin. A synergistic effect occurred when the materials were applied simultaneously; the bacterium was most susceptible to a 1 : 1 mixture of the two antibiotics. Roots of maize seedlings and leaves of older plants readily absorbed both antibiotics. Sunlight had no effect on the extent of absorption. Antibiotic treatment of maize leaves shortly before inoculation with *B. carotoverum* f. *zeæ* reduced the incidence and severity of leaf blight. The therapeutic effect extended at first both downwards and upwards but later only upwards. Leaf treatment did not induce resistance to infection in stems and roots. A. H. CORNFIELD.

Rearing of *Lyctus planicollis* and the preparation of wood for control tests. R. H. Smith (*J. econ. Ent.*, 1956, **49,** 127—129).—Successful rearing of *L. planicollis* beetles on oak or hickory is described. A. A. MARSDEN.

Transmission of resistance to chlordane in the German cockroach. J. M. Grayson, F. E. Jarvis, jun. and M. Levitan (*J. econ. Ent.*, 1956, **49,** 130—131).—The genetics of chlordane resistance in the German cockroach, *Blattella germanica*, was investigated. The factors for chlordane resistance in these roaches are autosomal. Little or no dominance was apparently involved in the activity of the autosomal factors. No indication of the influence of any cytoplasmic or sex-linked factors in the transmission of chlordane resistance was shown. A. A. MARSDEN.

Greenhouse tests on control of the beet leaf-hopper. H. C. Hallock and O. T. Deen (*J. econ. Ent.*, 1956, **49,** 123—126).—Of 33 compounds used in greenhouse tests as dusts and sprays, several gave good control of leafhoppers, *Circulifer tenellus*, but only Bulan, Colorado 9 [1 : 1 : 1-trichloro-2 : 2-bis-(*p*.-fluorophenyl)ethane], DDT, schradan, and TDE gave 80% reduction in curly top disease. Purified DDT, and Perthane (at 1·5 lb. per 100 gal.) were safe on Bountiful variety of beans, but technical DDT in emulsion sprays (containing di- and tri-methylnaphthalenes) caused stunting of snap beans. Naphthaleneacetic acid (25 p.p.m.) was safe on Bountiful beans and also decreased curly top disease. A. A. MARSDEN.

Granulated insecticides for European maize borer control. H. C. Cox, T. A. Brindley, W. G. Lovely and J. E. Fahey (*J. econ. Ent.*, 1956, **49,** 113—119).—Results of experiments with DDT, malathion, heptachlor and EPN indicated that granulated formulations of these insecticides were at least as effective as emulsion sprays in the control of *Pyrausta nubilalis*. There was little difference in the effectiveness of these four insecticides or between attapulgite and tobacco-base as carriers. A seeder-type duster was more satisfactory than a power duster for first and second brood borer control. A. A. MARSDEN.

Effect of formulations and methods of application of insecticides on the control of wireworms on sweet potatoes. L. L. Hyche and W. G. Eden (*J. econ. Ent.*, 1956, **49,** 111—113).—Different methods of application of aldrin, dieldrin, heptachlor, and lindane as dil. dusts, granules, and emulsions were used in the control of wireworms attacking sweet potatoes. Where wireworm injury was light all treatments were equally effective. Broadcast applications of granulated insecticides were rather more effective than other treatments for severe injury. Emulsifiable concentrates applied in the transplant water at planting time were the least effective. A. A. MARSDEN.

Field evaluation of malathion for control of California red scale on citrus. G. E. Carman (*J. econ. Ent.*, 1956, **49,** 103—111).—Preliminary field tests for the control of California red scale on citrus using malathion alone or with other materials and with various spray equipment are reported. At a dosage of ≮2 lb. of 25% wettable powder per 100 gal. malathion gave effective control of light and moderate infestations of this pest; application during the immediate postbloom period was essential for good control. Malathion was effective in combination with either parathion or various grades of petroleum oil, was relatively non-phytotoxic and did not increase insect or mite populations. A. A. MARSDEN.

Cultural practices affecting wireworm injury to potatoes. K. E. Gibson (*J. econ. Ent.*, 1956, **49,** 99—102).—Reduction in irrigation water did not give practical control of the Pacific Coast wireworm, *Limonius canus*; although reducing wireworm injury it also reduced the value of the crop. Delaying the planting date to June 20th or later reduced injury, probably due to the downward movement of the larvæ from the top soil to avoid high temp. A. A. MARSDEN.

Beet leafhopper and curly top conditions in the Southern Great Plains and adjacent areas. J. R. Douglass, W. E. Peay and J. I. Cowger (*J. econ. Ent.*, 1956, **49,** 95—99).—Approx. 50% reduction in yields of sugar beets affected by curly top disease in south-western Kansas was due to the extension of the spring breeding areas of the vector, the beet leafhopper, *Circulifer tenellus*. A. A. MARSDEN.

Resistance of lygus bugs to DDT on sugar beets grown for seed. O. A. Hills, E. A. Taylor and A. C. Valcarce (*J. econ. Ent.*, 1956, **49,** 94—95).—Evidence of the development of resistance to DDT by lygus bugs attacking seed beet is reported. Toxaphene gave satisfactory control of this pest. A. A. MARSDEN.

Chinch bug control on lawns in Florida. S. H. Kerr (*J. econ. Ent.*, 1956, **49,** 83—85).—DDT (10 lb. per acre) and parathion (1·5 lb. per acre) gave satisfactory control of chinch bugs attacking lawns in various districts of Florida, irrespective of the thickness of the turf. Chlordane, dieldrin, and Strobane were effective only on thin turf. A. A. MARSDEN.

Field tests with insecticides against cotton insects at Tallulah, La., in 1954. T. R. Pfrimmer and R. C. Gaines (*J. econ. Ent.*, 1956, **49,** 72—74).—Results of field experiments for control of the boll weevil, bollworm, cotton aphids, and spider mites are tabulated. Dieldrin–DDT, alone or with an acaricide, heptachlor–DDT, and aldrin–DDT : $C_6H_6Cl_6$ with DDT, alone or with an acaricide, $C_6H_6Cl_6$ dusts, endrin alone or with dieldrin, chlorthion, and endrin– or toxaphene–S all gave varying degrees of control of cotton pests and increased seed yields. γ-$C_6H_6Cl_6$ (3%)–DDT (5)–Aramite (2%), Am. Cyanamid 12008 and 12009 were the only treatments which decreased yields. A. A. MARSDEN.

Control of soil insects attacking groundnuts. B. W. Arthur and F. S. Arant (*J. econ. Ent.*, 1956, **49**, 68—71).—Damage to groundnut pods was caused chiefly by southern corn rootworm larvæ (*Diabrotica undecimpunctata howardi*), the banded cucumber beetle (*D. balteata*), the lesser cornstalk borer (*Elasmopalpus lignosellus*), and wireworms (*Conoderus* sp.). Soil applications of several chlorinated hydrocarbon dusts in the drills prior to planting reduced the insect damage but did not increase the yield of groundnuts. Aldrin and dieldrin (2 lb. per acre) or toxaphene (6 lb. per acre) applied as granules to the surface of the soil when the plants began to peg down reduced insect damage and also significantly increased yields. Gains from treatments on sandy soil were greater than those obtained on clay soil. A. A. MARSDEN.

Further laboratory tests for wireworm control. W. M. Kulash (*J. econ. Ent.*, 1956, **49**, 65—67).—Of nine materials applied in three different formulations in laboratory seed and soil treatments against wireworms, *Melanotus communis*, attacking maize, only four soil treatments were effective, viz., dieldrin–thiram, heptachlor on citrus pulp, lindane–thiram and endrin. Only three seed treatments, aldrin, heptachlor and chlordane on citrus pulp, produced a fairly good kill of wireworms. Endrin, pyrethrins–piperonyl butoxide, and 2 : 4-dinitrofluorobenzene gave little protection to the seed. Seeds treated with citrus pulp formulations had a high germination % in soil tests but a low rate in paper-towel tests. A. A. MARSDEN.

Treated cloth bags to control the rice weevil in maize. F. P. Sivik and W. M. Kulash (*J. econ. Ent.*, 1956, **49**, 64—65).—Eleven insecticides were sprayed on the insides of cotton twill bags which were then filled with untreated shelled maize. Pyrethrins–piperonyl butoxide and ryania dusts were also mixed with maize and stored in untreated bags. Six months after these treatments no significant weevil development was found in any of the bags except in those treated with Strobane and in untreated controls, both of which showed a marked increase in rice weevils. A. A. MARSDEN.

Effects of demeton and schradan on *Peregrinus maidis* (Ashm.) and its egg-predator *Cyrtorhinus mundulus* (Breddin). J. S. Verma (*J. econ. Ent.*, 1956, **49**, 58—63).—When determined by contact, demeton was much more toxic than schradan to both insects, and was about equally effective against the two species. Schradan was approx. three times as toxic to the pest as to its predator. Maize seed soaked in these insecticides produced plants toxic to leafhoppers, demeton being the more effective. When absorbed through the maize root system, demeton was more effective than schradan against leafhoppers but affected *C. mundulus* by fumigation through the leaves. Schradan was more persistent in the soil than was demeton. In a preliminary field trial, DDT controlled *Peregrinus maidis* longer than did demeton ; the latter affected the predator population almost as seriously as did DDT. Demeton (0·4 lb. per 100 gal.) caused serious phytotoxicity to maize. A. A. MARSDEN.

Some effects of microwaves on certain insects which infest wheat and flour. V. H. Baker, D. E. Wiant and O. Taboada (*J. econ. Ent.*, 1956, **49**, 33—37).—The effects of 12·25-cm. microwaves on the granary weevil and the flour beetle are reported. Wheat and flour were good absorbents of microwave energy ; no selective heating action was apparent between the wheat or flour and the insects infesting these products. A max. temp. of 74° at an exposure of 21 sec. in the Radarange apparatus killed 100 % of adult flour beetles one week after treatment. The larvæ required a temp. of 86°. Adult granary weevils were completely controlled one week after treatment at a temp. of 77·5° with an exposure of 15 sec. A. A. MARSDEN.

Black heart of pineapples. R. C. Cannon, F. W. Berrill and K. King (*Qd agric. J.*, 1955, **81**, 321—328).—The precise cause of black heart, a physiological breakdown on the flesh of maturing pineapple fruit, is not yet known. Since losses are greatest during July and August (winter) cultural practices should be such that harvesting during these two months is eliminated. Such cultural practices are described. A. H. CORNFIELD.

Vascular infection of cotton by *Xanthomonas malvacearum*, (E. F. Smith), Dowson. G. M. Wickens (*Ann. appl. Biol.*, 1956, **44**, 129—137).—The symptoms and development of vascular infection of cotton by *Xanthomonas* are described. Symptoms obtained under controlled conditions have also been observed in the field. Vascular infection is probably of greater significance than has been previously accepted in the epidemiology of the disease. A. H. CORNFIELD.

Factors governing the toxicity of DDT dust deposits to the pea aphid. G. A. Wheatley (*Ann. appl. Biol.*, 1956, **44**, 200—210).—Susceptibility of the apterous pea aphid to deposits of 1% DDT dust varied with stage of growth, being particularly low with the third instar aphids and high with the 1—3-day-old adult apteræ. Mortality increased with wt. of dust applied and also with fineness of the dust filler (talc). Deposits containing the coarsest particles were the most toxic where equal no. of particles were deposited per sq. mm. A. H. CORNFIELD.

Storage tests for the control of diseases and insect pests. H. C. Choudhuri (*Amer. Potato J.*, 1956, **33**, 6—14).—Of a no. of chemicals tested γ-$C_6H_6Cl_6$ and DDT powders dusted on the potatoes prior to storage (at 26·7—35·5°) were the most effective in reducing wt. losses and extent of loss due to decay (arising from *Phthorimea operculella* or *Fusarium ceruleum*). Fusarex (tetrachloronitrobenzene), Ceremul-C (paraffin-wax emulsion), Aretan (alkoxyalkyl Hg chloride) and Barsprout (Me naphthylacetate) were not quite so successful. A. H. CORNFIELD.

Control of red spider, *Tetranychus telarius*, L. C. F. H. Jenkins (*J. Agric. W. Aust.*, 1955, **4**, 145—150).—A general account of the characteristics and control of red spider. A. H. CORNFIELD.

Control of downy mildew of onions. R. F. Doepel and M. Hardie (*J. Agric. W. Aust.*, 1955, **4**, 313—318).—Of all the materials tested (five applications were given at 10-day intervals) only zineb (1·5 lb. + spreader per 100 gal.) gave significantly increased yields of onions. Thiram, ziram, captan, $CuOCl_2$ and lime–S had no effect on yields. A. H. CORNFIELD.

Control of cotton insect pests with Bayer 17147 [*OO*-dimethyl *S*-(4-oxobenztriazin-3-ylmethyl) phosphorodithioate]. C. F. Rainwater (*Agric. Chemicals*, 1956, **11**, No. 2, 32—33,107).—Tests at a no. of locations indicated that Bayer 17147 (0·25—0·50 lb. per acre) as spray or dust gave consistently better control of the boll weevil than did currently recommended insecticides, and also gave fairly effective control of aphids and mites. 0·5—0·75 lb. of the material per acre gave better control of the bollworm than did DDT. A. H. CORNFIELD.

Control of powdery mildew and leafspot of cherry. P. R. Miller (*Agric. Chemicals*, 1956, **11**, No. 2, 55—56, 97—101).—A combination of actidione (2 p.p.m.) and S (2—5 lb. per 100 gal.) gave excellent control of both diseases when applied four times at 14-day intervals. Cu fungicides gave good leafspot control, but were usually unsatisfactory for controlling powdery mildew. A. H. CORNFIELD.

Control of foliar nematodes in lucerne and daffodils. P. R. Miller (*Agric. Chemicals*, 1956, **11**, No. 1, 58—60, 102).—*Ditylenchus dipsaci* in lucerne was controlled by application of 0·05—0·20% diethyl 1-chlorovinyl phosphate (**I**) as spray or drench. The higher concn. was somewhat phytotoxic. At least three applications were necessary for complete control. Application of 0·1—1·0% Systox and 0·1—1·0% **I** gave excellent control of *D. dipsaci* in lucerne and daffodils. The max. effect of the former occurred four weeks, and of the latter one week, after application. Both materials caused leaf tip burn at 0·5—1·0% concn. 0·1—1·0% octamethylpyrophosphoramide was not quite as effective. A. H. CORNFIELD.

Systemic control of cotton pests with Thimet (*OO*-diethyl *S*-isopropylmercaptomethyl dithiophosphate). Anon. (*Agric. Chemicals*, 1956, **11**, No. 1, 67).—When cotton seeds were treated with the insecticide thrips, aphids, and spider mites were controlled for 3—7 weeks after emergence. Cotton fleahoppers were controlled for four weeks following emergence. Leaf miner and whitefly damage was reduced and cutworms were also controlled. Control of the bollworm was erratic. A. H. CORNFIELD.

Control of parasitic nematodes with D-D. P. R. Miller (*Agric. Chemicals*, 1956, **11**, No. 3, 53—54).—D-D (30 gal. per acre) was injected into the soil in April and strawberry plants were put in 39 days later. Nematode infestation of roots was low in both treated and control plots during this season. In the following year infestation was much lower in treated than in control plots. Yields of berries were increased only in the second year following treatment. A. H. CORNFIELD.

Nemagon, 1 : 2-dibromo-3-chloropropane, a soil fumigant. C. C. Compton and S. H. Benedict (*Agric. Chemicals*, 1956, **11**, No. 3, 46—47, 125—126).—A review of recent studies with Nemagon. The material can be applied (2·5—10 gal. per acre) to the soil where certain crops (citrus, grapes, peaches, grasses, etc.) are growing. The material can be formulated with fertilisers and does not give off-flavours. A. H. CORNFIELD.

Berry fruit spraying trials. I. D. Geard (*Tasm. J. Agric.*, 1955, **26**, 243—253).—Tests with raspberries over two seasons showed that Bordeaux mixture (6 : 4 : 40), TMTD, ferbam, and S.R.406 (*N*-trichloromethylthiotetrahydrophthalimide) gave effective control of anthracnose and spur blight. The only schedules which controlled raspberry leaf rust were those containing Bordeaux mixture at the white bud stage. A green tip spray of Bordeaux mixture or DNOC reduced leaf spot on blackcurrants and further reductions were obtained when TMTD, S.R.406, or Bordeaux mixture was

applied when fruit was half-grown. Bordeaux mixture reduced the vitamin C content of the fruit when applied later than the green tip stage. A. H. CORNFIELD.

Diseases of peaches and nectarines. J. R. Ward (*Tasmanian J. Agric.*, 1955, **26**, 52—58).—A no. of fungus diseases and symptoms due to deficiency of N, K, Ca and Fe are described. Methods of control are given. A. H. CORNFIELD.

Wheat stem sawfly damage in four spring wheat varieties as influenced by date of seeding. F. H. McNeal, M. A. Berg and P. Luginbill, jun. (*Agron J.*, 1955, **47**, 522—525).—Loss in kernel wt. due to sawfly of two solid- and two hollow-stemmed spring wheat varieties over two years when sown on three dates was studied. In a year of relatively high available moisture the losses were less than 5% whilst in a year of low available moisture losses exceeded 20% with some varieties. Solid-stemmed varieties were affected to a lesser extent than were hollow-stemmed varieties. The extent of tunnelling was greater in hollow- than in solid-stemmed varieties. Sawfly damage decreased as sowing date was delayed, but was still serious even when sowings were made in early June. A. H. CORNFIELD.

Grasshopper control. J. R. Dutton (*Agric. Chemicals*, 1956, **11**, No. 3, 32—33).—A general account. A. H. CORNFIELD.

Control of nematodes in strawberries with 3-*p*-chlorophenyl-5-methylrhodanine. P. R. Miller (*Agric. Chemicals*, 1956, **11**, No. 3, 54—55).—Application, in July, of this substance (300—500 lb. per acre) between the rows of strawberry plants significantly increased yields of berries in the following season and did not alter the flavour of the fruit. The treatment reduced the no. of parasitic nematodes in the soil. A. H. CORNFIELD.

Rose diseases in Tasmania. G. C. Wade (*Tasm. J. Agric.*, 1955, **26**, 135—141).—A no. of diseases of roses and their control are described. A. H. CORNFIELD.

Control of apple and pear pests in the granite belt. A. W. S. May and M. Bengston (*Qd agric. J.*, 1955, **81**, 277—284).—General recommendations for the control of the pests attacking apple and pear trees in the area are described. A. H. CORNFIELD.

Control of the green peach aphid on burley tobacco. G. M. Boush, K. J. Starks and R. Thurston (*J. econ. Ent.*, 1956, **49**, 24—27).—Of eight non-systemic and five systemic materials tested against *Myzus persicæ* on burley tobacco, parathion and Chlorthion, both in the laboratory and in the field (0·3—0·4 lb. per acre) were highly effective and about equal in toxicity. Lindane and endrin gave <80% reduction of aphids in field tests. A. A. MARSDEN.

Parathion, EPN, dieldrin and methoxychlor for control of the plum curculio on prunes. E. H. Smith, M. M. Grainger and A. W. Avens (*J. econ. Ent.*, 1956, **49**, 14—18).—In the field, dieldrin closely followed by EPN, were the most satisfactory materials for curculio control. Methoxychlor was very persistent but had low toxicity and speed of action. Parathion was highly toxic and the most effective insecticide against immature stages. In the field, however, it gave the poorest control due to its short residual effectiveness. A. A. MARSDEN.

Orchard mite control. D. S. Morris (*J. Agric. Victoria*, 1955, **53**, 551—555, 558).—Excellent control of bryobia mite (*Bryobia prætiosa*, Koch) for 6—8 weeks on both Delicious apples and Williams' Bon Chretien pears was obtained with single applications of Ovotran, PCPBS (*p*-chlorophenyl benzenesulphonate), and Chlorparacide in late Nov. On pears no further applications were necessary prior to harvest, whilst on apples a second application was necessary in early Feb. Parathion and malathion gave rapid initial reduction of mites on apples, but were inferior to the other materials for long-term protection. Red oil, "Superior Oil", and PCPBS were superior to Ovotran and Chlorparacide against the overwintering egg stage of the mite. Aramite was the most effective of all materials tested for red spider control. A. H. CORNFIELD.

Control of the common field cricket, *Acheta commodus*, W. T. W. Hogan and I. A. Barber (*J. Agric. Victoria*, 1955, **53**, 544—546).—Application, in Feb., of dieldrin (8 oz.) or aldrin (16 oz.) per acre, both mixed with superphosphate, gave fairly effective control of the field cricket in pastures. γ-$C_6H_6Cl_6$ was relatively ineffective even at 16 oz. per acre. A. H. CORNFIELD.

Locust problem in Victoria. T. W. Hogan (*J. Agric. Victoria*, 1955, **53**, 497—502).—A general account dealing with past outbreaks and present methods of control. A. H. CORNFIELD.

Moisture and other environmental factors in relation to the control of nematodes by fumigation, with special reference to the golden nematode. M. B. Harrison (*Dissert. Abstr.*, 1956, **16**, 193).—The effects of moisture and temp. on the control of nematodes, e.g., *Heterodera rostochiensis* Woll., *Meloidogyne* sp., *Xiphinema* sp. and *Turbatrix acetii* (Muller) Peters, by the soil fumigants 1 : 2-dichloropropane + 1 : 3-dichloropropene, trichloronitromethane, 1 : 2-dibromoethane, and Na *N*-methyldithiocarbamate dihydrate were investigated. O. M. WHITTON.

Literature of chemical weed control. C. J. Willard and E. K. Alban (*J. agric. Food Chem.*, 1956, **4**, 454—455).—Sources of information on weed control are discussed. E. M. J.

Wetting ability of aqueous herbicidal sprays as a factor influencing stands of lucerne seedlings. K. P. Dorschner and K. P. Buchholtz (*Agron. J.*, 1956, **48**, 59—63).—Aq. solutions of hormone-type herbicides varied considerably in wetting ability as measured by spreading coeff. on waxed slides and lucerne leaves. Toxicities of various 2 : 4-D prep. to lucerne seedlings varied considerably but were more comparable when the solutions were adjusted to equal spreading coeffs. with a wetting agent. Spreading coeff. was not a reliable index of the toxicity of a given herbicide. Toxicity to lucerne seedlings decreased in the order 2 : 4-D, 2 : 4 : 5-T = MCPA, CPA, 3 : 4-D, 2 : 5-D. Shading the plants increased the wettability of their leaves and also increased their susceptibility to damage by 2 : 4-D. A. H. CORNFIELD.

Herbicide specifications and laboratory evaluation procedures. J. W. Suggit (*Proc. 9th annu. Mtg Northeast Weed Control Conf.*, 1955, 453—458).—Recommendations for the laboratory evaluation of ester formulations of the chlorophenoxyacetic acids (2 : 4-D and 2 : 4 : 5-T particularly) comprise: nature and amount of acid, % of Cl, sp. gr., flash point, pour point, storage stability (24 hr. at 125°F. without separation of components or loss of emulsifying capacity), low temp. stability (alternate freezing and thawing), emulsion stability and homogeneity, surface tension, breaking time, ease of re-emulsification, dispersion in hard water and volatility (tested with bean seedlings). A. G. POLLARD.

Penetration of chlorinated phenoxyacetic acids into leaves. K. Holly (*Ann. appl. Biol.*, 1956, **44**, 195—199).—The highest rate of penetration of aq. MCPA into leaves occurred with sunflower, which is highly susceptible to the chemical, and the lowest with oats, pea, linseed and runner beans (the first three species have some degree of resistance). Addition of a surface-active agent to aq. MCPA increased its rate of penetration into oats leaves but did not greatly increase the extent of damage caused. Differences in rate of penetration between species probably plays only a minor part in governing the selective phytotoxicity of MCPA. A. H. CORNFIELD.

Field trials with 3 : 4-D on lucerne and medium red clover. M. M. Schreiber (*Proc. 9th annu. Mtg Northeast. Weed Control Conf.*, 1955, 335—339).—3 : 4-Dichlorophenoxyacetic acid was less effective than 2 : 4-D or MCP (notably against *Barbarea vulgaris*) but was much less injurious to lucerne and medium red clover. A. G. POLLARD.

Use of new arsenicals [as herbicides]. C. R. Skogley and G. H. Ahlgren (*Proc. 9th annu. Mtg Northeast. Weed Control Conf.*, 1955, 401—405).—In preliminary trials cacodylic acid showed outstanding phytotoxic properties. A. G. POLLARD.

Synthesis of *N*-*p*-chlorophenyl-*N'N'*-dimethylurea. Fan-tih Chiang (*J. Chinese chem. Soc.*, 1955, **II**, **2**, 129—131).—*N*-*p*-Chlorophenyl-*N'N'*-dimethylurea (**I**), useful as a weedkiller, is obtained (yield 82·2%) by the reaction of *p*-chlorophenyl *iso*cyanate (**II**) with dry gaseous $PhNMe_3$ in PhCl at 8°, the solvent being distilled under reduced pressure. The crude **I** is recrystallised (rhombic prisms, m.p. 160—170°) from warm conc. $C_2H_4Cl_2$. **II** is prepared by heating *p*-chlorocarbamyl chloride, which is formed by the controlled action of $COCl_2$ on *p*-$C_6H_4Cl{\cdot}NH_2$ in ethylene dichloride. W. J. BAKER.

Chemical defoliation of cotton. V. Effects of premature defoliant treatments on boll composition, fibre properties and yield of cotton. L. C. Brown and A. H. Hyer (*Agron. J.*, 1956, **48**, 50—55).—When chemical defoliants ($NaClO_3$, pentachlorophenol, Na ethyl xanthate) were applied to portions of the plant on which bolls were less than 35 days old, yields, boll size, no. of seed per boll, seed and lint indices, fibre length and germination were reduced. No damage resulted when the chemicals were applied to portions of the plant where bolls were more than 35 days old. A. H. CORNFIELD.

Control of wild radish, *Raphanus raphanistrum* L. G. R. W. Meadly (*J. Agric. W. Aust.*, 1955, **4**, 161—169).—The weed was controlled in wheat by application, when wheat was 8 in. high and stooling, of MCPA or 2 : 4-D(amine) (4—6 oz. of acid-equiv. per acre). A. H. CORNFIELD.

Control of doublegee, *Emex australis*. G. R. W. Meadly and G. A. Pearce (*J. Agric. W. Aust.*, 1955, **4**, 229—230).—Application of 2 : 4-D as amine, ethyl ester, butoxyethanol ester, or alkyl-hexyl ester (6—16 oz. of acid-equiv. per acre), to 9-in. high stooling wheat and again nine days later gave complete control of doublegee in the crop. Control from a single application was usually incomplete. At another location even the double application gave poor control. A. H. CORNFIELD.

Control of doublegee, *Emex australis*. G. R. W. Meadly (*J. Agric. W. Aust.*, 1955, **4**, 321—325).—Hormone-type weedicides have not given consistent results in the control of this weed, although its competitive effect can usually be reduced by spraying with 6 oz. of 2 : 4-D (acid equiv.) per acre. 1% aq. Dinoc (30% dinitro-*o*-cresylate) containing 0·2% $(NH_4)_2SO_4$ has given good control of doublegee in cereals without permanently injuring the latter, but the material is expensive and is not adapted to low-vol. spraying. A. H. CORNFIELD.

Effect of herbicidal treatments on oats. C. G. Waywell (*Proc. 9th annu. Mtg Northeast. Weed Control Conf.*, 1955, 391—397).—The effects of 2 : 4-D and MCP in Bu-ester and amine formulations were compared in applications of 6—12 oz. per acre. Oat plantswere most liable to injury by these herbicides during the 3½ weeks after emergence. In general 2 : 4-D prep. lowered the final yield more than the MCP prep. The Bu ester of 2 : 4-D was more injurious than was the amine form. A. G. POLLARD.

Effect of spray volume and rate of dinitro-herbicide on weed control and clover stand in undersown oats. M. F. Trevett (*Proc. 9th annu. Mtg Northeast. Weed Control Conf.*, 1955, 407—415).—In trials with dinitro-*o-sec.* butylphenol (**I**) (amine salt) on a crop of clover undersown with oats, damage to the oats from a pre-emergence application was related to the total amount of **I** applied, regardless of the vol. of spray used (20—80 gal.). Damage to the clover in its susceptible stage increased with the amount of **I** used (up to 1·5 lb. per acre) and, with equal applications of **I** was greater when the spray vol. was high. A. G. POLLARD.

Control of Noogoora burr, *Xanthium pungens*, Wallr. G. R. W. Meadly (*J. Agric. W. Aust.*, 1955, **4**, 33—38).—Characteristics of Noogoora burr, a serious weed of pasture, are described. Control measures include hoeing and burning. Small plants are controlled by application of 1 lb. of 2 : 4-D (acid-equiv.) per acre. Biological control with the seed-fly (*Euaresta æqualis*) introduced from the U.S. has been disappointing since the fly has shown no tendency to increase. A. H. CORNFIELD.

Second year effects of various herbicides on the yield and botanical composition of [mixed forage] legumes. M. M. Schreiber and S. N. Fertig (*Proc. 9th annu. Mtg Northeast. Weed Control Conf.*, 1955, 313—323).—The importance of observing recovery (>2 years) effects of herbicidal treatments of forage crops is demonstrated. The reduction in the proportion of lucerne in mixed herbage associated with increasing applications of translocated herbicides is a permanent effect. A. G. POLLARD.

Chemical weed control in new grass-legume sowings. J. Vengris and W. G. Colley (*Proc. 9th annu. Mtg Northeast. Weed Control Conf.*, 1955, 305—311).—Best control of chickweed was obtained by use of the alkanolamine salt of dinitro-*o-sec.* butylphenol (0·75—1·0 lb. per acre) ; this and also 3 : 4-dichlorophenoxyacetic acid were effective on other dicotyledonous weeds. When the weed species included mustard or when lucerne was a component of the seed mixture 3 : 4-D was preferable to 2 : 4-D. A. G. POLLARD.

Comparison of MCP and 2 : 4-D for weed control in forage legumes. M. M. Schreiber (*Proc. 9th annu. Mtg Northeast. Weed Control Conf.*, 1955, 325—334).—Injurious effects of the two herbicides on red clover, lucerne, birdsfoot trefoil and ladino clover are examined. With applications up to 0·25 lb. per acre recovery from injury increased with the height of the plant when treated. Applications of 0·5 lb. per acre injured all crops at all periods of application. A. G. POLLARD.

Downy cress control in lucerne. J. Vengris (*Proc. 9th annu. Mtg Northeast. Weed Control Conf.*, 1955, 301—303).—Dalapon (3—6 lb. per acre) was highly effective in destroying the cress in lucerne. A. G. POLLARD.

Effect of selected herbicides applied at the time of sowing lucerne. A. O. Kuhn, W. E. Garvey, jun., T. H. Schutte and M. Wilcox (*Proc. 9th annu. Mtg Northeast. Weed Control Conf.*, 1955, 293—299). —The herbicides were applied between rows of lucerne simultaneously with the seed. Spring applications were ineffective. When sowing was done in late summer, pulverised $CaCN_2$, *iso*propyl *N*-(3-chlorophenyl)carbamate alone or in combination with MCP lowered weed growth for about two months but did not affect the stand of lucerne at the time of first cutting in the following spring. A. G. POLLARD.

[A] Comparison of 4-Chlorol, 3 : 4-D, MCP 2 : 4-D and 2 : 4 : 5-T for the control of white clover in turf. [B] Persistence of clover control in putting green turf treated with Endothal and 2 : 4 : 5-T. J. A. Jagschitz and J. F. Cornman (*Proc. 9th annu. Mtg Northeast. Weed Control Conf.*, 1955, 371—374, 375—383).—[A] Of the materials examined 2 : 4 : 5-T gave the most promising results. The Bu ester was more effective than the triethanolamine or pentyl ester formuations when applied at the rate of 0·75 lb. of acid-equiv. per acre. With a 1·5 lb. dosage the three derivatives gave similar results. Admixture of equal wt. of 2 : 4-D and 2 : 4 : 5-T did not increase the efficiency of clover control.

[B] A mixture of Endothal containing Na_2 3 : 6-*endo*-oxohexahydrophthalate 16 and $(NH_4)_2SO_4$ 84% was more effective, one year after treatment, than was Endothal alone or Endothal + $(NH_4)_2SO_4$ in the proportion 2 : 1. Of formulations of 2 : 4 : 5-T the Bu ester was superior to the amine type. In general 2 : 4 : 5-T prep. were more satisfactory than the Endothal prep. A. G. POLLARD.

Tolerance of red clover and lucerne to autumn applications of 2 : 4-D, MCP and 4-Chlorol. R. J. Aldrich (*Proc. 9th annu. Mtg Northeast. Weed Control Conf.*, 1955, 289—291).—The growth and yield of lucerne were unaffected by applications of 3 : 4-D (0·5 lb. per acre) but were lowered somewhat by 4-Chlorol (4-chlorophenoxyacetic acid) used at the same rate. 2 : 4-D and MCP (0·25 lb. per acre) were more injurious. Red clover tolerated 0·5 lb. of MCP per acre. A. G. POLLARD.

Crabgrass control. J. E. Gallagher and B. H. Emerson (*Proc. 9th annu. Mtg Northeast. Weed Control Conf.*, 1955, 385—389).—KCNO (8 lb.) and Na_2 methyl arsonate (6·8 lb. per acre) were the most efficient materials tested for eliminating crabgrass and increasing the proportion of permanent turf grasses with min. discoloration of the latter. A. G. POLLARD.

Pre-emergence control of smooth crabgrass in lawn turf with chemicals. S. W. Hart and J. A. Defrance (*Proc. 9th annu. Mtg Northeast. Weed Control Conf.*, 1955, 345—349).—Effective control was obtained by pre-emergence applications of HgPh acetate or *N*-1-naphthylphthalamic acid. A. G. POLLARD.

Two years' test and demonstration work on turf renovation using calcium cyanamide. J. A. McFaul (*Proc. 9th annu. Mtg Northeast. Weed Control Conf.*, 1955, 341—343).—Application of $CaCN_2$ (40—80 lb. per 1000 sq. ft.) to a turf seedbed maintained the herbicidal action into the second season. The effect was optimum when the application was made to a slightly moist soil ; heavy rain following the treatment lowered its efficiency. Weed control was complete when the treated soil was at ~70°F. but was poor when the temp. was 40°F. A. G. POLLARD.

Control of annual blue grass (*Poa annua*) in fairway type turf. R. E. Engel and R. J. Aldrich (*Proc. 9th annu. Mtg Northeast. Weed Control Conf.*, 1955, 353—355).—In a bent grass-blue grass type of turf max. reduction in the proportion of *P. annua* and of clover with min. damage to turf grasses resulted from early spring application of a Na 3 : 6-endoxohexahydrophthalate prep. (Endothal). Na_3AsO_3 used carefully by experienced workers was also effective. Maleic hydrazide controlled *P. annua* but severely injured the desirable turf grasses. A. G. POLLARD.

Chemical control of goosegrass (*Eleusine indica*) in greens-type turf. R. E. Engel and R. J. Aldrich (*Proc. 9th annu. Mtg Northeast. Weed Control Conf.*, 1955, 357—358).—Best results were obtained with an emulsifiable prep. of 2 : 4-dichlorophenoxyethyl benzoate. A. G. POLLARD.

Control of *Veronica filiformis* in turf using potassium cyanate, Endothal, 2 : 4-D and 2 : 4 : 5-T. J. A. Jagschitz and J. F. Cornman (*Proc. 9th annu. Mtg Northeast. Weed Control Conf.*, 1955, 365—369). —Of the materials tested Endothal (Na_2 3 : 6-*endo*-oxohexahydrophthalate) gave the most satisfactory control. Use of 7 lb. in 200 gal. of water per acre is recommended. A. G. POLLARD.

Comparison of standard and new brush-killer formulations. W. A. Meyers, W. W. Allen and R. H. Beatty (*Proc. 9th annu. Mtg Northeast. Weed Control Conf.*, 1955, 433—438).—Differences in the effects of 2 : 4-D and 2 : 4 : 5-T on various species of brushwood due to differences in formulation are recorded. A. G. POLLARD.

Effect of certain brush control techniques and materials on game food and cover on a power-line right-of-way. II. W. C. Bramble and W. R. Byrnes (*Proc. 9th annu. Mtg Northeast. Weed Control Conf.*, 1955, 417—427).—Numerous comparative trials of various formulations of 2 : 4-D, 2 : 4 : 5-T and "Ammate" on woody brush are described. A. G. POLLARD.

Effect of spray volume on reduction of re-sprouting of red maple following stub treatment with 2 : 4 : 5-T. M. F. Trevett (*Proc. 9th annu. Mtg Northeast. Weed Control Conf.*, 1955, 471—477).—In concn. of 2—4 lb. per 100 gal. of kerosene, 2 : 4 : 5-T prevented resprouting of the stubs. A. G. POLLARD.

Animal Husbandry

Improvement of pastures in the world. A. T. Semple (*Ét. agric. de la FAO*, 1956, No. 16, 169 pp.).—A review, international in scope, covering the importance and rôle of pasturage in agriculture,

improvement of common pastures, exploitation of cattle, sowing and fertilisers, soil preparation and burning, National pasturage improvement programmes, forage trees and shrubs, complementary feeding, and the need for research. (Bibliography 331 references; footnotes, 107 references.) J. S. C.

Officially graded hay and its chemical composition. R. C. Wakefield, W. H. Hosterman, R. A. Briggs, G. H. Ahlgren and S. B. Randle (*Agron. J.*, 1955, **47**, 507—509).—The average chemical composition of hays divided into 16 official hay classes is presented. Crude protein and ash content decreased and crude fibre and N-free extract (NFE) increased with decreasing legume content of the hays. The chemical composition of hays divided into three quality grades, showed that for predominantly legume hay classes U.S. No. 1 hay was generally superior to U.S. No. 2 and/or U.S. No. 3 hay in crude protein, ether extract, ash, and NFE and lower in crude fibre content. In predominantly grass hay classes differences between grades were limited to a higher NFE content of the No. 1 and 2 grades as compared with the No. 3. A. H. CORNFIELD.

Aspects of the rôle of maize in animal nutrition in S. Africa. P. K. van der Merwe (*J. S. Afr. Vet. Med. Assoc.*, 1955, **26**, 199—208).—The composition of and deficient food factors in maize, notably proteins, amino-acids, minerals and vitamins, appropriate supplementation and the effects of germ removal on feeding quality are summarised. Factors to be considered in the use of maize as a major component of rations for laying hens and for pigs are discussed. A. G. POLLARD.

Effect of added fats and oils on carotene stability in dehydrated lucerne meal during storage. R. L. Ogden (*J. agric. Food Chem.*, 1956, **4**, 428—431).—The stability of carotene in lucerne meal varies with different lots of meal depending on the type of antioxidant-carotene deposition in the meals. Animal fats added to dehydrated lucerne meal caused a marked increase in carotene-stabilising action over that resulting from the addition of vegetable oils. Lower grade, inedible animal fats may cause increased carotene degradation in some meals. E. M. J.

Phosphatase test for determining heat treatment of lucerne meal. G. P. Sanders, J. A. Hupfer and H. G. Wiseman (*J. Dairy Sci.*, 1956, **39**, 561—567).—A modified phosphatase test is described for detecting adulteration of heat-dehydrated lucerne meal by cheaper and nutritionally inferior field-dried lucerne or other non-heat-treated materials. The test, based on the complete inactivation of alkaline phosphatase occurring during heat treatment, is reliable and approx. quant., and is capable of detecting as little as 1% adulteration. S. C. JOLLY.

Nutritive value of fish proteins. D. S. Miller (*J. Sci. Food Agric.*, 1956, **7**, 337—343).—The protein quality of commercial fish meals is impaired to a variable extent during the drying process; this impairment is caused by the action of heat in the presence of moisture and is the result of the Maillard reaction. Low-temp. drying is recommended and an attempt was made to find "anti-Maillard" substances. For rats, methionine is the limiting amino-acid in the damaged meals and might be added with advantage to these products. On storage, fish meals retain their feeding value for at least three months. (55 references.) E. M. J.

The biological value of yeast protein. H. Leopold (*Chem. Tech., Berlin*, 1956, **8**, 155—159).—Protein nutrition in animals is discussed. The nutrient value of dried yeast lies between that of the best plant proteins and the animal proteins in respect of essential amino-acids. The suitability of dried yeast products for use in animal fodder and supplementary use of essential amino-acids and vitamins are discussed. Analyses of several dried yeast products produced by culture in waste liquor are compared with other reported analyses especially of the contents of purine and of the various essential amino-acids. (45 references.) H. L. WHITEHEAD.

Technological development problems of yeast culture in sulphite cellulose waste lyes. R. Winter (*Chem. Tech., Berlin*, 1956, **8**, 145—155).—The operation of commercial processes for growing yeast and animal fodder yeast (*Torula utilis*) in neutralised waste liquor from the sulphite cellulose digestors or from distillery slop is discussed. H. L. WHITEHEAD.

Characteristics of rumen bacteria isolated from cattle fed high and low roughage rations. L. R. Maki (*Dissert. Abstr.*, 1955, **15**, 2385—2386).—The five major groups of bacteria isolated were designated by the following main acids they produced: butyric, propionic, acetic, lactic or succinic. The effects of high and low roughage rations on both microscopical and cultural counts, and on the groups are described. O. M. WHITTON.

Utilisation of non-protein nitrogen by rumen micro-organisms *in vitro*. T. V. Hershberger (*Dissert. Abstr.*, 1956, **16**, 227).—Factors responsible for nutritional quality of rations that increase the utilisation of non-protein N by rumen micro-organisms were identified using three commercial N-containing prep. (viz., ammoniated molasses, wheat hydrolysate and biuret) on the rate of growth of the micro-organisms in a synthetic medium. The optimum pH range was 6·0—7·5. O. M. WHITTON.

Stratifications and kinetic changes in the ingesta of bovine rumen. P. H. Smith, H. C. Sweeney, J. R. Rooney, K. W. King and W. E. C. Moore (*J. Dairy Sci.*, 1956, **39**, 598—609).—Significant differences in all factors except alcohol-sol. sugars were found between samples of ingesta from the top and bottom of the rumen of 2-year-old fistulated steers over a 12-hr. period including two feedings; except for ether extract and amount of *in-vitro* cellulose digestion, concn. of all factors were higher in the top samples. These data, together with significant time fluctuations, indicated that hay and grain particles follow different physical pathways in traversing the rumen. The same stratification occurred in non-fistulated steers. S. C. JOLLY.

Effect of stilbœstrol administration on weight gains of animals. I. van Schalkwyk (*J. S. Afr. vet. med. Ass.*, 1955, **26**, 221—226).—A summary of recent work. A. G. POLLARD.

Chemical determination of 17-hydroxycorticosteroids in the blood of cattle and some indications of its physiological significance. W. G. Robertson and J. P. Mixner (*J. Dairy Sci.*, 1956, **39**, 589—597).—A routine method is described for the determination of total free 17-hydroxycorticosteroids in bovine blood plasma. The method is based on a micro modification of the Porter–Silber colour reaction (*J. biol. Chem.*, 1950, **185**, 201), depending on the formation of phenylhydrazones in acid solution, and is specific for 17 : 21-dihydroxy-20-ketosteroids. The mean plasma-17-hydroxycorticosteroids of 23 dry pregnant cows was 9·77 μg. (range 6·90—17·62) per 100 ml.; for 20 non-pregnant lactating cows the figure was 4·58 μg. (range 2·14—8·40). A mean increase of 120% in plasma 17-hydroxycorticosteroids resulted 2 hr. after the intermuscular injection of 600 Armour Veterinary Units of ACTH to six cows. S. C. JOLLY.

Effect of egg yolk and its isolated constituents on the dehydrogenase activity of bovine spermatozoa. J. T. Smith, D. T. Mayer and C. P. Merilan (*J. Dairy Sci.*, 1956, **39**, 552—560).—Whole egg yolk stimulated the succinic, malic and glyceraldehyde-3-phosphate dehydrogenase activity of bovine spermatozoa; this effect was associated with the acetone-sol. fraction of yolk and was apparently due to the stimulatory effect of cholesterol and carotene on succinic dehydrogenase activity; cholesterol inhibited the other two dehydrogenase activities. Possible mechanisms of this stimulation and inhibition and the apparent failure of lecithin to stimulate succinic dehydrogenase activity are discussed. S. C. JOLLY.

Effect of thyroidectomy and iodine supplementation on the plasma-protein-bound-iodine of a Jersey bull. R. C. Lewis (*J. Dairy Sci.*, 1956, **39**, 610—611).—Thyroidectomy (by ^{131}I administration) of a young Jersey bull resulted in the protein-bound I (PBI) of the plasma decreasing from 6·7 μg. to 3·4 μg. by the 18th day and to 0·8 μg. per 100 ml. by the 33rd day; for several months afterwards the average level was 0·5 μg. (range 0·0—1·4 μg.). These results suggest that the plasma-PBI of dairy cattle is closely related to thyroxine. Both PBI and total I levels of plasma were raised considerably by six successive daily doses of 1 g. of Cu_2I_2, increasing respectively from 0·0 and 1·8 μg. per 100 ml. to max. of 25·5 and 948 μg. per 100 ml. on the 6th day; 52 days later the respective levels were still 8·4 and 20·2 μg. per 100 ml. The plasma-PBI of dairy cattle receiving supplementary I may contain a non-thyroid fraction. S. C. JOLLY.

Ovarian functions, intervals between œstrus, and conception rates in dairy cattle. G. W. Trimberger (*J. Dairy Sci.*, 1956, **39**, 448—455).—Data covering a 5-year period and 400 cows are considered. The influence of cystic ovaries on breeding efficiency is examined. S. C. JOLLY.

Carbohydrate metabolism in ruminants with special reference to ketosis. R. Clark and K. E. Weiss (*J. S. Afr. Vet. Med. Ass.*, 1955, **26**, 217—220).—Effects of a change of diet on volatile acid production in sheep are examined. The rumen flora can adapt itself to extensive dietary changes and main healthy conditions. A sudden alteration of diet may result in changes in the relative and absolute amounts of fatty acids formed and in metabolic disorders. The adaptation of rumen flora, to even minor changes in diet, may occupy 3—4 weeks. Processes leading to ketoses and hypoglycæmia in ruminants are discussed. A. G. POLLARD.

Ketosis in dairy cattle. J. C. Shaw (*J. Dairy Sci.*, 1956, **39**, 402—434).—A review with 143 references. S. C. JOLLY.

Outdoor rearing of calves on grass with special reference to growth rate and grazing behaviour. J. H. B. Roy, K. W. G. Shillam and J. Palmer (*J. Dairy Res.*, 1955, **22**, 252—269).—Spring-born calves

were raised successfully out of doors in England on permanent pasture from birth; except for a limited amount of whole milk during the first weeks, pasture grass was the sole item of diet. After adjusting for birth-wt. differences, month of birth had little effect on live-wt. gains, which were similar to those of animals reared by conventional methods. Parasitic infestation was generally above normal, but apparently had little adverse effect on growth. Details of the calves' grazing habits are reported. S. C. JOLLY.

Effect of lecithin, choline and methionine on the vitamin A and carotene plasma levels and liver stores of young dairy calves. C. L. Davis, R. F. Elliot and C. A. Lassiter (*J. Dairy Sci.*, 1956, **39**, 440—447).—The feeding of either methionine, choline or lecithin had little value in increasing the absorption and utilisation of supplementary vitamin A in young calves. Methionine and choline increased the absorption of supplementary carotene, but none of the lipotrophic agents affected liver storage of carotene. Ether extract and total solids of liver and kidneys were not affected by any of the supplements. S. C. JOLLY.

Fish liver-oil for ruminants on pasture. E. Kraak (*Ernährungsforschung*, 1956, **1**, 122—127).—The max. daily dose of fish liver-oil tolerated without abnormal effects by kids or calves aged 1·5—2 months is 10—15 g. P. S. ARUP.

Nipple *versus* pail feeding of milk to Holstein calves. E. M. Kesler, R. D. McCarthy and C. B. Knodt (*J. Dairy Sci.*, 1956, **39**, 542—546).—Calves fed milk from an open pail until six weeks of age consumed the milk more quickly, and showed superior growth compared with nipple-fed calves; the difference in growth was not substantiated in two subsequent trials. Incidence of scours was similar however the milk was fed. S. C. JOLLY.

Input-output relationships in feeding dairy cows. M. B. Jawetz (*Dairy Sci. Abstr.*, 1956, **18**, 1—20).—A critical review provides evidence of the need of reconsideration of food requirements per unit of milk production. A. G. POLLARD.

Comparative value of Kentucky bluegrass, Kentucky 31 fescue, orchard grass and bromegrass as pastures for milk cows. I. How kind of grass affected persistence of milk production, total-digestible-nutrient-yield, and body weight. D. M. Seath, C. A. Lassiter, J. W. Rust, M. Cole and G. M. Bastin. **II. Effect of kind of grass on dry matter and crude protein content and digestibility and intake of dry matter.** C. A. Lassiter, D. M. Seath, J. W. Woodruff, J. A. Taylor and J. W. Rust (*J. Dairy Sci.*, 1956, **39**, 574—580, 581—588).—I. In a 3-year trial only minor and insignificant differences were found between Kentucky bluegrass, Lincoln bromegrass and orchard grass when highly fertilised and used as pasture crops for dairy cows. Kentucky 31 fescue was inferior to these grasses, particularly in maintaining high milk production and body wt. of the animals.

II. The daily intake of dry matter by cows grazing the fescue was significantly lower than that by cows on the other grasses, and is apparently the chief cause of the lower persistency of milk flow of animals on this pasture, although another factor(s) may be involved. The contents and digestibilities of dry matter and crude protein of the four grasses and their seasonal trends are reported.
S. C. JOLLY.

Phosphorus supplements for dairy cows. L. C. Snook (*J. Agric. W. Aust.*, 1955, **4**, 175—186).—An account of methods of supplying extra P to dairy cows. A. H. CORNFIELD.

Secretion of milk of low fat content by cows on diets low in hay and high in concentrates. VI. Effect on physical and biochemical processes of reticulo-rumen. C. C. Balch, D. A. Balch, S. Bartlett, M. P. Bartrum, V. W. Johnson, S. J. Rowland and J. Turner (*J. Dairy Res.*, 1955, **22**, 270—289).—During the feeding of low-hay high-concentrate diets, milk-fat % were $<2·0$ compared with $\sim3·5\%$ for control animals and were not increased by addition of straw pulp to the diet; Reichert values of the butterfat were markedly reduced and I values were increased. Decreases in milk-fat % occurred only on diets containing large amounts of starch and lacking in fibre. Digestion in the reticulo-rumen of cellulosic constituents of the diets was markedly reduced, while that of starch was virtually complete. The time spent by the animals in ruminating was shortened. With low-hay diets peak concn. of total volatile fatty acids were raised, but pH was lower and amounts of acetate present much reduced although amounts of propionate were almost unchanged. The amount of acetic acid absorbed from the reticulo-rumen is probably reduced on these diets and may account for the lowered milk-fat. S. C. JOLLY.

Effect of progesterone therapy on embryo survival in cows of lowered fertility. J. N. Wiltbank, H. W. Hawk, H. E. Kidder, W. G. Black, L. C. Ulberg and L. E. Casida (*J. Dairy Sci.*, 1956, **39**, 456—461).—Injection of 50 or 200 mg. of progesterone daily beginning three days after heat resulted in a slight and nonsignificant increase in embryonic survival at 34 days in repeat-breeder cows. S. C. JOLLY.

Relative value of maize, oats and hominy when fed with molasses to fattening yearling steers on pasture. E. A. Pierce (*Dissert. Abstr.*, 1956, **16**, 200).—The relative nutritive value of combinations of one-half ground maize, ground oats, or hominy and one-half molasses when fed to fattening yearling steers on pasture, were determined. The maize-molasses feed gave slightly higher grade carcasses. Economic factors are discussed. O. M. WHITTON.

Cobalt deficiency in sheep. R. I. Thain (*Tasmanian J. Agric.*, 1955, **26**, 154—164).—Application of $CoSO_4$ (1 lb. per acre) to a pasture on basaltic soil increased the wt. gains of lambs by 60% over three months. Fortnightly drenching of lambs, reared on pasture on a red-brown basaltic soil, with Co increased wt. gains over four months by 61% and eliminated mortality.
A. H. CORNFIELD.

Sheep-branding fluids. P. H. D'Emden (*Tasmanian J. Agric.*, 1955, **26**, 213—220).—Trials of a no. of proprietary branding fluids, including scouring tests, are described. A. H. CORNFIELD.

Cabbage poison, *Velleia discophora*, F. Muell. C. A. Gardner and H. W. Bennetts (*J. Agric. W. Aust.*, 1955, **4**, 193—194).—Symptoms of toxic poisoning of sheep which consumed the plant are described.
A. H. CORNFIELD.

Pig feeding trial with [supplementary] Agfa-yeast. E. Kraak (*Ernährungsforschung*, 1956, **1**, 118—121).—The consumption during 90 days of a total of 13·5 kg. of supplementary yeast gives an average gain of 3·5 kg. of meat per pig, the value of which approx. equals that of the yeast. Yeast forms a wholesome supplement for growing pigs.
P. S. ARUP.

Effect of vitamin B_{12} on live-weight increases in growing pigs. E. Kraak (*Ernährungsforschung*, 1956, **1**, 112—117).—Methods for the prep. of vitamin B_{12}-containing extracts from clarified sewage sludge include essentially the addition of KCN (1—2 mg. per kg.), heat sterilisation, and concentration by evaporation under reduced pressure or in a current of hot air. Daily supplements of the extract ($\equiv 36$ μg. of B_{12}) increased average gains in wt. by growing pigs by $\sim54\%$. Similar results obtained with the use of fish-solubles are quoted. (22 references.) P. S. ARUP.

Trial of fish-oil residues as supplement to the diet for pregnant and suckling sows. E. Kraak (*Ernährungsforschung*, 1956, **1**, 128—132).—The prep. under test, "Ferkelsan", is a by-product of the manufacture of fish-liver oil. and contains vitamins A, D, B_1, B_2 and B_{12}. Supplementation of the diet of a pregnant sow with Ferkelsan increased the wt. at birth of a litter of 11 by 4 kg. and improved their general condition in comparison with a litter of 11 of a control sow. During the suckling period, the experimental sow lost appreciably more wt. than did the control sow, but gains in wt. by the control litter were greater than those of the experimental litter.
P. S. ARUP.

Effect of supplementary fat in the rations of lactating swine. R. Norman (*Dissert. Abstr.*, 1956, **16**, 199—200).—A study of the lactation performance of swine fed rations supplemented with different levels of animal fat is reported. The fat increased feed efficiency but not the mean weaning wt. O. M. WHITTON.

Environment and poultry breeding problems. II. Comparison of egg production of seven Single Comb White Leghorn strains housed in laying batteries and floor pens. R. S. Gowe (*Poultry Sci.*, 1956, **35**, 430—435).—Differences in egg production and body wt. of survivors obtained with the two housing methods varied with strain. Differences in total egg production, date of sexual maturity, egg. wt. and mortality between the two methods of housing were independent of strain. A. H. CORNFIELD.

Efficiency of performance testing in poultry. J. F. Hill and A. W. Nordskog (*Poultry Sci.*, 1956, **35**, 256—265).—Effects of hybrid variety, location, year, and their interactions on egg production and mortality are reported for 55 inbred varieties tested at 13 locations for one year and for 10 varieties tested at four locations over three consecutive years. A. H. CORNFIELD.

Feed consumption in relation to dietary bulk and energy level. Effect of surgical removal of the crop. H. Fisher and H. S. Weiss (*Poultry Sci.*, 1956, **35**, 418—423).—Addition of 10% of fibre to the diet of chicks to 19—21 days of age increased feed consumption, had no effect on wt. gains, but increased feed efficiency in some cases. Surgical removal of the crop of chicks reduced wt. gains and feed consumption for approx. one week after treatment, but thereafter treated chicks gained as well and consumed as much as did normal chicks. A. H. CORNFIELD.

Effect of day-length on rate of growth, feed conversion, feathering, and market quality of turkeys. M. G. McCartney (*Poultry Sci.*, 1956, **35**, 468—475).—Tests with poults hatched in June and Jan. and subjected to natural and artificial lighting conditions indicated that turkeys require a 13—15 hr. day for max. growth and feed utilisation. Varying day-length had no consistent effect on feathering or market quality. A. H. CORNFIELD.

Effect of period of exposure to different stress stimuli on endocrine and lymphatic gland weights of young chickens. H. W. Garren and C. S. Shaffner (*Poultry Sci.*, 1956, **35**, 266—272).—Exposing 7-week-old chickens to 6·6° for 1—4 weeks caused adrenal hypertrophy. A decrease in thyroid wt. occurred after one week, followed by an increase by the third week. Administration of thiouracil (0·2% in the feed) to 4-week-old birds for 3—6 days resulted in adrenal enlargement. Administration for 3—12 days caused a lymphatic involution. Administration of thyroprotein (0·03% in the feed) for 12 days caused adrenal hypertrophy. Birds 3 weeks old subjected to reduced atm. pressure (equiv. to altitude of 12,000—15,000 ft.) for 1 hr. showed lowered wt. of spleen; increased adrenal wt. occurred after 5—12 hr., whilst a lymphatic involution occurred after 4—12 hr. All the stress stimuli except the thyroprotein treatment produced enlargement of the pituitary at some time during the exposure period. A. H. CORNFIELD.

Lysine requirement of chicks. H. M. Edwards, jun., L. C. Norris and G. F. Heuser (*Poultry Sci.*, 1956, **35**, 385—390).—Slow-growing chicks (starch–wheat gluten diet) required $\leqslant$0·9% of lysine in the feed for optimum growth to four weeks of age. Fast-growing chicks (starch–sesame meal diet) required $\leqslant$1·1% of lysine to 4—6 weeks of age. A. H. CORNFIELD.

Utilisation of D-tryptophan by the chick. W. D. Morrison (*Dissert. Abstr.*, 1956, **16**, 199).—The utilisation of D-tryptophan by the young chick was studied using wt. gain and N balance as the criteria. The chick is able to utilise D-tryptophan without assistance from the intestinal bacteria. Efficiency of absorption of the amino-acid is an important factor. O. M. WHITTON.

Effects of certain factors on the amino-acid requirements of the chick. P. Griminger (*Dissert. Abstr.*, 1956, **16**, 198—199).—The relation of the amino-acid (methionine, tryptophan and lysine) requirements of growing chicks to protein level, bulkiness of the diet, and rate of growth of chicks was investigated. No significant differences in amino-acid requirements were found for optimum growth in fast- and slow-growing groups of chicks. O. M. WHITTON.

Feather meal in chick nutrition. R. J. Lillie, J. R. Sizemore and C. A. Denton (*Poultry Sci.*, 1956, **35**, 316—318).—Feather meal supplied at the 1·5—5·0% level (partially or completely replacing fish meal) to birds receiving an all-vegetable diet fortified with all known nutrients was as effective as was fish meal in increasing growth rate to 4—10 weeks of age. A. H. CORNFIELD.

Substance in fish solubles which enhances vitamin-A storage in chick livers. R. H. Harms, A. A. Camp, B. L. Reid, E. L. Grant, B. G. Creech and J. R. Couch (*Poultry Sci.*, 1956, **35**, 285—291).—An unidentified water-sol. factor(s) present in fish solubles enhanced the storage of vitamin A in the liver of chicks from 3—10 weeks of age. A. H. CORNFIELD.

Effect of equalised feed intake on the response of chicks to fish meal. M. W. Moeller and H. M. Scott (*Poultry Sci.*, 1956, **35**, 491—492).—Addition of 10% of fish meal to the diet of chicks from 7 to 21 days of age increased growth rate and feed efficiency to a greater extent where *ad libitum* feeding was allowed than where feed intake was equalised. Feed consumption was increased by the addition of fish meal. A. H. CORNFIELD.

Relationship between protein level and energy level in chick rations. M. L. Sunde (*Poultry Sci.*, 1956, **35**, 350—354).—The effects of two protein levels (20% or 28%) and varying productive energy level (655 to 932 kg.-cal. per lb. of feed), obtained by adding 5—10% white grease to the diets of chicks, up to 4—10 weeks of age, were studied. Increasing the energy level of the 20% protein diet had no consistent effect on growth rate but increased feed efficiency. Increasing the energy level of the 28% protein diet increased both growth rate and feed efficiency. A. H. CORNFIELD.

Chick growth response to egg yolk, animal fat and fish solubles additions to the diet. G. H. Arscott (*Poultry Sci.*, 1956, **35**, 338—342).—The effect of the additions to a purified diet thought to be adequate in vitamins, minerals and amino-acids was studied. Animal fat and fish solubles probably contain the same unidentified growth factor, whilst egg yolk contains this and one other factor. A. H. CORNFIELD.

Fat in poultry nutrition. I. The chick from hatching to five weeks of age. A. L. Davidson (*J. Sci. Food Agric.*, 1956, **7**, 240—244).—The conflicting evidence on the value of fat in poultry rations appears to depend on whether or not a proper balance has been maintained between energy and protein. There is a narrow range of ratio of total digestible nutrients to crude protein which gives max. efficiency, but where there is correct balance between these constituents the addition of oil or fat consistently improves growth rate and feed conversion. E. M. J.

Phosphorus requirement of the young pheasant. M. L. Sunde and H. R. Bird (*Poultry Sci.*, 1956, **35**, 424—430).—Pheasant chicks required $\leqslant$0·96% of P in the diet for optimum bone ash values at four weeks of age. Those receiving 0·66% of P showed high mortality, symptoms of leg weakness, and bending of the tarsometatarsus. Addition of 0·3—0·8% of $CaHPO_4$ prevented these troubles. A. H. CORNFIELD.

Effects of fats and fatty acids in chick rations. M. L. Sunde (*Poultry Sci.*, 1956, **35**, 362—368).—Addition of 5% of white grease, yellow grease, prime tallow and No. 1 tallow to the feed slightly improved growth rate and feed efficiency of chicks to four weeks of age. Brown grease, commercially stabilised fat, hydrogenated fat, oleic acid, linolenic acid, and linoleic acid had no effect on growth rate, but, with the exception of hydrogenated fat, improved feed efficiency. Stearic acid (5%) had no effect on growth rate or feed efficiency and its utilisation was not improved by a dispersing agent or a surfactant. Crude tall oil (5%) depressed growth severely. Feed efficiency was improved to about the same extent when white grease was added to medium- or high-energy rations. Chicks given free access to both types of rations consumed about twice as much feed containing added fat as of that not containing added fat. A. H. CORNFIELD.

Feeding value of hydrolysed vegetable fats in broiler rations. L. V. Curtin and J. T. Raper (*Poultry Sci.*, 1956, **35**, 273—278).—Addition of 3% of hydrolysed cottonseed fat, distilled cottonseed fatty acids, distilled animal fatty acids, or animal grease to a 20%-protein diet had no effect on growth rate of birds from 0 to 8 weeks of age, but improved feed efficiency. Higher levels of added fat did not improve feed efficiency further. Even 6% fat was not detrimental to growth. A. H. CORNFIELD.

Degossypolised cottonseed meal as a substitute for soya-bean oil meal in a turkey growing mash. J. W. West (*Poultry Sci.*, 1956, **35**, 304—307).—Addition of 0—20% of degossypolised solvent-extracted cottonseed meal (0·65% total gossypol), replacing soya-bean oil meal, to the diet of turkeys from 8—28 weeks of age had no effect on growth rate, feed efficiency, uniformity or livability. Combinations of the two meals improved growth slightly but consistently in comparison with the use of either meal alone. A. H. CORNFIELD.

Lack of effect of a synthetic poultry feed flavouring material on chick growth and feed efficiency. J. R. Sizemore and R. J. Lillie (*Poultry Sci.*, 1956, **35**, 360—361).—Addition of a synthetic feed-flavouring material (containing extractives of anise, rose, cinnamon, lemon and orris) to the diet of chicks to four weeks of age had no effect on growth rate or feed efficiency. A. H. CORNFIELD.

Response of growing and mature pullets to continuous feeding of cane final molasses. M. M. Rosenberg and A. L. Palafox (*Poultry Sci.*, 1956, **35**, 292—303).—Addition of up to 23·0—28·5% of cane final molasses (replacing maize meal) to the diet of pullets from 0—24 weeks of age did not reduce growth rate but lowered feeding costs. Growth was depressed where higher levels of the molasses were supplied. Onset of maturity and rate of lay to 24 weeks of age were unaffected even with 34·5% of molasses in the diet. Diets having 28·5% of the molasses up to 48 weeks of age had no effect on egg production or quality or on feed efficiency with respect to egg production. Levels >7·5% depressed body wt. gains and those >16·5% increased egg soilage. Mortality was not increased to 72 weeks of age even where 34·5% of the molasses was given. A. H. CORNFIELD.

Vitamin B_{12} requirements of White Leghorn chicks. R. F. Miller, L. C. Norris and G. F. Heuser (*Poultry Sci.*, 1956, **35**, 342—349).—During the first six weeks after hatching chicks required $\geqslant$0·25 μg. of vitamin B_{12} per 100 g. of feed if their dams received sufficient vitamin B_{12} to promote 63% hatchability of fertile eggs. Where dams received more vitamin B_{12} and eggs showed 83% hatchability the chicks required $\geqslant$0·125 μg. of vitamin B_{12} per 100 g. of feed; they required somewhat more where a high- than where a low-productive energy diet was supplied. Hatchery chicks may require supplemental vitamin B_{12} for their first six weeks of life. A. H. CORNFIELD.

Chick viability and pantothenic acid deficiency in the breeding diet. H. Fisher and C. B. Hudson (*Poultry Sci.*, 1956, **35**, 487—488).—High mortality of chicks was traced to a deficiency of pantothenic acid in the dams' diet. The trouble was eliminated by adding the vitamin to the drinking water. A. H. CORNFIELD.

Effect of antioxidants and vitamin B_{12} on the utilisation of carotenoid pigments by the chick. L. M. Potter, R. H. Bunnell, L. D. Matterson and E. P. Singsen (*Poultry Sci.*, 1956, **35**, 452—456).—Addition of 0·0125% of diphenyl-*p*-phenylenediamine (**I**) to a semi-purified vitamin-A low ration with lucerne meal as the sole source of carotene substantially increased the amounts of vitamin A and carotenoids in the blood plasma and liver of chicks to four weeks of

age. Addition of 0·0125% of 2 : 6-di-*tert.*-butyl-4-methyl phenol resulted in relatively small increases. Addition of vitamin B_{12} (0·012 g. per ton of feed) to a practical maize–lucerne meal ration had no consistent effect on the vitamin A and carotenoids in the liver and blood plasma of chicks to nine weeks of age, but increased the amounts of carotenoids in the skin. Addition of **I** to this ration increased slightly vitamin A and carotenoid storages whilst a combination of vitamin B_{12} and **I** produced substantial increases.
A. H. CORNFIELD.

Reproduction in turkeys as influenced by 4-nitrophenylarsonic acid. R. E. Moreng and R. L. Bryant (*Poultry Sci.*, 1956, **35,** 406—409).—Administration of 4-nitrophenylarsonic acid (1 lb. per 160 gal. of drinking water) to the dams depressed egg production and size of poults at hatching. At eight weeks of age there were no differences in wt. of poults between treated and control dams (poults did not receive the drug). The treatment had no effect on hatchability, fertility of eggs, or livability of poults produced.
A. H. CORNFIELD.

Chick growth response to condensed fish solubles and varying levels of Terramycin. E. L. Wisman, C. E. Holmes and R. W. Engel (*Poultry Sci.*, 1956, **35,** 457—462).—Addition of Terramycin hydrochloride (0·01—0·20 g. per lb. of feed) to the diet of chicks (reared in batteries and receiving an all-vegetable diet) to four weeks of age had no effect on wt. gains. Addition of 5% of fish solubles increased wt. gains. The high levels of antibiotic increased wt. gains when fish solubles were present. Responses to the treatments were similar whether the batteries were located in old or new quarters and whether or not droppings were removed. A. H. CORNFIELD.

Comparison of different methods of progesterone administration to the fowl in affecting egg production and moult. J. L. Adams (*Poultry Sci.*, 1956, **35,** 323—326).—Yearling hens were treated with progesterone as follows : orally at the rate of 0·11—0·22 g. per kg. of feed ; by a single intramuscular injection of 0·05 g. ; by pellets (0·028—0·051 g.) implanted subcutaneously in the neck ; by weekly injections for 3—6 weeks of 0·025 g. each. Body wt. was unaffected by any whilst egg production was depressed by all treatments. The rate of moult of primary wing was increased by all treatments, except the pellet implantation and the single muscular injection. The weekly injection treatment was the most effective in inducing moult. Oral administration of progesterone was slower to take effect than were the injection methods.
A. H. CORNFIELD.

Gonad and comb response of mature male chickens to diethylstilbœstrol as influenced by breed and dosage. R. E. Moreng, R. L. Bryant and D. G. Gosslee (*Poultry Sci.*, 1956, **35,** 476—482).—The effect of diethylstilbœstrol (**I**) implantation (0·012 g. weekly for 1—4 weeks or one 0·024-g. dose) on 8—10 month-old birds of five breeds was studied. The treatments decreased testis size, comb area, and comb wt. The extent of responses to the treatments varied with breed. The responses increased with dosage and no. of administrations of **I**. Younger birds responded more readily than did older birds. A. H. CORNFIELD.

Effect of frequency of gathering of eggs upon hatchability. W. C. Skoglund and A. W. Brown (*Poultry Sci.*, 1956, **35,** 369—371).—Frequency of gathering of eggs (once to four times per day at 3-hr. intervals or nine times per day at hourly intervals) had no effect on % hatchability of fertile eggs throughout the year.
A. H. CORNFIELD.

Albumin quality as affected by time after break-out. J. V. Spencer, W. J. Stadelman, E. A. Sauter and J. G. Darroch (*Poultry Sci.*, 1956, **35,** 319—322).—Albumin quality (as determined by measuring albumin height after breaking out the egg on a flat glass plate) declined linearly with the log. of the elapsed time (10 sec. to 10 min.) from breakout. The rate of decline varied with hen and age of egg. A. H. CORNFIELD.

Factors influencing the lysozyme level of egg white. F. H. Wilcox, jun. (*Poultry Sci.*, 1956, **35,** 278—284).—Lysozyme concn. of eggs decreased during the first laying year. This decrease was partially associated with increase in egg wt. Lysozyme concn. of eggs laid during the second year exceeded the average for eggs laid during the first year. The decrease with time during the first laying year was an effect of season rather than of age of the hen. There were significant differences in lysozyme concn. between 12 strains but not between four breeds. A. H. CORNFIELD.

Effect of 2-acetamido-5-nitrothiazole on egg production, fertility, hatchability and weight gains in chickens. R. J. Price and P. E. Gingher (*Poultry Sci.*, 1956, **35,** 327—333).—Pullets (12·5 weeks old) and cockerels (10—16 weeks old) were supplied with 0·0075—0·0150% of 2-acetamido-5-nitrothiazole in the mash each day for 14 days or with 0·015—0·030% intermittently (three days on—four days off) so that they received the medicated diet for 12 days. The treatments had no significant effect on wt. of cockerels or pullets 11·5 weeks after start of medication or on egg production and wt., fertility or hatchability. A. H. CORNFIELD.

Effect of supplemental methionine in a maize-soya-bean diet for laying chickens. B. W. Heywang (*Poultry Sci.*, 1956, **35,** 462—468).—Addition of vitamin B_{12} (5 μg. per lb. of feed) or 0·05—0·085% DL-methionine to a maize-soya-bean meal type diet (containing 0·28% of L-methionine) had no consistent effect on egg production, egg wt., shell thickness, feed efficiency with respect to egg production, or pullet wt. Hatchability was increased only by the vitamin B_{12} treatment. Addition of 0·025—0·050% of DL-methionine to diets containing soya-bean meal or soya-bean meal–fish meal + added vitamin B_{12} had little effect on egg production, feed efficiency with respect to egg production, egg wt., shell thickness, or hatchability.
A. H. CORNFIELD.

Effect of diethylstilbœstrol on dressing and cooking losses of New Hampshire broiler-fryers. D. Fromm and P. H. Margolf (*Poultry Sci.*, 1956, **35,** 254—256).—Cockerels implanted with diethylstilbœstrol (0·012 g.) at eight weeks of age had a higher dressing % at 13 weeks of age than did untreated birds. Half-carcasses of treated birds showed slightly greater total cooking losses than did those of untreated birds. A. H. CORNFIELD.

Flavour and aroma of birds fed purified and standard diets. R. W. Lewis, P. E. Sanford, A. T. Ericson, D. L. Harrison and R. E. Clegg (*Poultry Sci.*, 1956, **35,** 251—253).—A low-fat purified diet and standard high-efficiency diet were fed to chicks reared on wire floors for 8—10 weeks. The mean flavour and aroma scores of broth and press-extracted juice from the birds as well as of the light and dark meat were consistently higher where the standard than where the purified diet had been fed to the birds. A. H. CORNFIELD.

Keeping quality of ready-to-cook and dressed poultry. R. C. Baker, H. B. Naylor, M. C. Pfund, E. Einset and W. Staempfli (*Poultry Sci.*, 1956, **35,** 398—406).—Bacterial counts and flavour of ready-to-cook (blood and feathers removed, eviscerated) carcasses were compared with those of dressed carcasses (blood and feathers removed). Bacterial counts were higher at the start and increased more rapidly with storage in the case of the ready-to-cook carcasses. These carcasses also had the higher flavour rating and showed less hydrolytic rancidity than did dressed carcasses. Flavour scores of various portions of the carcass are also presented.
A. H. CORNFIELD.

Rapid method for preparing whole chick carcass samples for analysis. R. B. Kerber and F. H. Bird (*Poultry Sci.*, 1956, **35,** 486—487).—The carcass is homogenised in a Waring Blendor, moisture is removed by lyophilisation, and the dry residue is used for analysis.
A. H. CORNFIELD.

Research on the use of systemic insecticides for the control of livestock pests. W. S. McGregor and R. C. Bushland (*J. econ. Ent.*, 1956, **49,** 86—88).—Recent research on systemic insecticides for the control of screw-worms, cattle grubs, blood-sucking flies, lice and lone star ticks is reviewed. Although subcutaneous injections in oil of lindane and related compounds were effective, the use of this compound is limited to veterinary workers. Oral doses of phosphorus insecticides made treatment much easier and gave promising results. A. A. MARSDEN.

Toxicological problems in the use of systemic insecticides for livestock. R. D. Radeleff and G. T. Woodard (*J. econ. Ent.*, 1956, **49,** 89—91).—The following problems are discussed : safety for the treated animal, residues in animal tissues and products, administration by injection or orally, the effects of simultaneous operations, and other factors such as nutritional anæmias and mineral deficiencies in the test animals. A. A. MARSDEN.

Tests with self-treating devices for the control of lice on cattle in Mississippi. W. W. Neel (*J. econ. Ent.*, 1956, **49,** 138—140).—Back-rubbers impregnated with chlordane (5%) in fuel or motor oil controlled sucking lice (*Solenopotes capillatus, Linognathus vituli* and *Bovicola bovis*) on beef cattle confined in small feed lots. Preliminary tests using toxaphene also at 5% concn. were satisfactory. Back-rubbers placed on large range posts, using either toxaphene (5%) or toxaphene (5)-lindane (0·3)% in fuel oil failed to control lice. A. A. MARSDEN.

Use of chloropromazine hydrochloride ("Largactil") in an equine case of tetanus. L. W. van der Heever (*J. S. Afr. vet. med. Ass.*, 1955, **26,** 301—303).—"Largactil" in conjunction with antitoxin and antibiotic therapy gave satisfactory results.
A. G. POLLARD.

Field test of malathion to control sarcoptic mange of hogs. E. S. Raun and R. H. Ahrens (*J. econ. Ent.*, 1956, **49,** 140).—Spraying hogs severely infested with the mange mite, *Sarcoptes scabiei suis*, with malathion sprays (0·5 and 1%) completely eliminated the mangy

condition in 19 days. No symptoms of toxicity or skin irritation from sprays of up to 2% concn. were noted on the pigs.
A. A. MARSDEN.

Control of the itch mite of sheep (*Psorergates ovis*, Womersley). O. G. H. Fiedler and R. Du Toit (*J. S. Afr. vet. med. Ass.*, 1955, **26**, 231—235).—In trials with a no. of insecticides, the most effective control of the mite, without damage to the wool, was obtained with δ-$C_6H_6Cl_6$. Neither γ-$C_6H_6Cl_6$, aldrin, dieldrin, chlordane, Strobane, nor DDT had any effect on the mites. A. G. POLLARD.

Mycotic dermatitis (lumpy wool) and fleece rot of sheep. C. R. Toop (*J. Agric. W. Aust.*, 1955, **4**, 281—283).—These conditions are most likely to occur during seasons of excessive rainfall. Mycotic dermatitis is due to *Actinomyces dermatonomus* and is controlled by dipping sheep in late autumn in aq. $CuSO_4.5H_2O$ or $ZnSO_4.7H_2O$ (1 lb. per 50 gal.). Fleece rot is related to the wax content of the wool, high-yielding fleeces with low wax content being the most susceptible. Shearing immediately prior to the onset of the rainy season is recommended, but is rarely practicable in Western Australia. Sheep suffering from either condition are rendered more susceptible to blowfly strike. A. H. CORNFIELD.

Physico-chemical studies on the application of insecticides to sheep fleece. VII. Influence of cationic wetting agent-fleece reactions on the stability of emulsions and suspensions. C. C. Addison and C. G. L. Furmidge (*J. Sci. Food Agric.*, 1956, **7**, 281—290).—A study is made of the stability of dil. xylene–water emulsions, and DDT–water suspensions whan cationic wetting agents (of chain length in the range dodecylpyridinium to octadecylpyridinium, and with various halide ions) are employed. Factors which may contribute to the stability of dilute emulsions and additional complicating factors introduced in the presence of fleece are discussed and classified. E. M. J.

Depletion of insecticidal emulsions in contact with sheep fleece. A. F. Machin (*J. agric. Food Chem.*, 1956, **7**, 330—337).—Depletions of insecticide and solvent from emulsions of BHC, DDT, dieldrin and aldrin in contact with sheep fleece were caused by the grease associated with the fleece. There was a higher rate of depletion with BHC and dieldrin than with DDT and aldrin. The mechanism of depletion is discussed especially with reference to differences between these insecticides. The concn. of BHC in an emulsion in contact with fleece fell to its equilibrium value in ~30 min. and roughly $\frac{1}{2}$ of this loss occurred in 1 min. (the usual period of dipping). (21 references.) E. M. J.

Field tests with new tick repellents in 1954. H. K. Gouck and I. H. Gilbert (*J. econ. Ent.*, 1955, **48**, 499—500).—Field tests with 21 repellents and 9 repellent mixtures in areas heavily infested with the lone star tick, *Amblyomma americanum*, are reported. None of the new mixtures was as effective as the standard, M-1960 [2-ethylhexane-1:3-diol (30)–*N*-butylacetanilide (30)–benzyl benzoate (30%)]. The most effective individual repellent was 1-butyryl-1:2:3:4-tetrahydroquinoline. A. A. MARSDEN.

Evaluations of some new insecticides against lice on livestock and poultry. C. L. Smith and R. Richards (*J. econ. Ent.*, 1955, **48**, 566—568).—Of several chlorinated hydrocarbons tested against lice infesting cattle, goats and poultry, Strobane was as effective as DDT, toxaphene or chlordane. Of the P compounds, Malathion and Diazinon gave promising results. The P compounds did not show the residual effectiveness of the chlorinated hydrocarbons, but they were effective at much lower concn. No toxic symptoms to animals or poultry were noticed. A. A. MARSDEN.

Malathion to control the northern fowl mite. W. C. Harding, jun. (*J. econ. Ent.*, 1945, **48**, 605—606).—Treatment of the dry litter with 4% Malathion dust (0·5 and 1 lb. per 20 sq. ft.) and a little of the insecticide dust mixed into each nest gave very effective control of the northern fowl mite, *Bdellonyssus sylviarum*, on hens in 1—4 days. Heavy infestations of mites on roosters were controlled only by dusting the birds individually with 4% Malathion. A. A. MARSDEN.

Control of the gapeworm (*Syngamus trachea*) in the ring-necked pheasant. M. R. Anderson and J. Shapiro (*Conn. agric. Exp. Sta.*, 1955, *Bull.* 315, 12 pp.).—Methods of control involving treatment of infected birds have not been satisfactory. Since the main infection occurs through the bird picking up the worm and free-living larvæ from the soil, methods involving soil treatment to control the pest have been successful. Of various chemicals tested DD (47 gal. per acre injected at 4 in. depth) has given the best results.
A. H. CORNFIELD.

Control of stickfast flea of poultry. B. W. Moffatt (*Qd agric. J.*, 1955, **81**, 239—241).—Characteristics of the flea are described. Infested birds should be wholly immersed in 1% DDT suspension and feathers and skin thoroughly wetted by agitation.
A. H. CORNFIELD.

Evaluation of immunity to fowl pox. I. Immunisation of young chicks with pigeon-pox and fowl-pox vaccines. K. C. Seeger and R. J. Price. **II. Immunisation of young chicks with fowl-pox vaccine.** R. J. Price and K. C. Seeger (*Poultry Sci.*, 1956, **35**, 372—379, 379—384).—I. When challenged 40 and 80 days after vaccination pigeon-pox vaccine was only slightly effective as compared with fowl-pox vaccine as an immunising agent for 1—15-day-old chicks. Neither vaccine caused any deaths and both were compatible with Newcastle and infectious bronchitis vaccines.

II. Of the birds tested 93·8% showed a satisfactory reaction to fowl-pox vaccine. Age at vaccination (1—15 days old) had no effect on the no. of "takes." The no. of "takes" and the no. of birds showing satisfactory immune response decreased with the amount of diluent used. Comb scarification was a more severe route of challenge than was wing-web puncture. All birds showing "take" were immune by wing-web challenge after 40 days and 92·3% were immune at 80 days. A. H. CORNFIELD.

Flock history after immunisation with a combination Newcastle disease–infectious bronchitis vaccine. F. S. Markham, A. W. Sylstra, A. H. Hammar and P. Gingher (*Poultry Sci.*, 1956, **35**, 390—397).—A commercial laying flock which was vaccinated at 29 days of age with a combination dust vaccine was protected against the clinical effects of Newcastle disease and infectious bronchitis for at least six months and possibly for 12 months. There may be a physiological increase in antibody production associated with max. reproductive activity. A. H. CORNFIELD.

Egg changes following avian respiratory diseases. I. Diseases associated with egg changes. R. W. Hill and F. W. Lorenz (*Poultry Sci.*, 1956, **35**, 409—417).—The effects on egg quality of several field outbreaks and of controlled laboratory infections of respiratory diseases are described. The outbreaks reduced egg size and shell and albumin quality. A. H. CORNFIELD.

Encephalomalacia in the chick. V. Effect of fish oil and diphenyl-*p*-phenylenediamine on the vitamin-E metabolism of the chick. R. H. Bunnell, L. D. Matterson, E. P. Singsen and H. D. Eaton (*Poultry Sci*,. 1956, **35**, 436—451).—The tocopherol stores of the livers of day-old normal chicks (from dams receiving adequate vitamin E) were much greater than those of the livers of deficient chicks from dams receiving a vitamin-E low diet. These values equalised after 10—15 days on the same diet. Addition of vitamin E (8 i.u. per lb. of feed) to the chicks' diet increased the tocopherol content of blood plasma and liver, but had little effect on the lipin content of the liver. Only normal chicks responded to vitamin E additions. Addition of 0·05% of diphenyl-*p*-phenylenediamine to the chicks' diet had no effect on liver or plasma tocopherol levels but increased the liver tocopherol stores of the vitamin E-deficient chicks. Growth, particularly of the vitamin E-deficient chicks, was stimulated and the lipin content of the liver was increased by this treatment. Addition of 2% of fish oil to the diet depressed growth and the tocopherol levels of blood plasma and liver, and decreased the lipin content of the liver. A. H. CORNFIELD.

Preparation of sulphonated hydroxymethylacrylamide polymers and copolymers [soil conditioners]. American Cyanamid Co. (B.P. 738,047, 30.4.53. U.S., 20.6.52).—An acrylamide substituted in the α-position with alkyl of 1—4 C is condensed (1 mol.) with formaldehyde ($\leq$0·05 mol.), either before or after polymerisation (or copolymerisation with a hydrophobic vinyl compound, e.g., styrene (1—99 wt.-%), and the resulting hydroxymethylated polymer is treated with H_2SO_3 or water-sol. salt thereof ($NaHSO_3$) $\leq$0·05 mol., to give a strongly hydrophilic, anionic product useful as soil conditioner. F. R. BASFORD.

Soil of improved structure. Monsanto Chemical Co. (B.P. 736,540, 20.3.53. U.S., 22. and 24.3.52).—Soil structure is improved by incorporation of a water-insol., pulverulent vinyl (or α-substituted-vinyl) cyanide polymer (or copolymer thereof with $\geq$75% of another vinyl compound, e.g., styrene), optionally used in conjunction with alkaline-earth metal (Ca) oxide, hydroxide or carbonate.
F. R. BASFORD.

Separation of stem portions from disintegrated tobacco mass. Arenco A.-B. (B.P. 739,868, 2.4.54. Swed., 29.4.53).—The tobacco is elutriated with air, stem fragments falling into a bin, and leaf fragments being carried upwards and over into a large chamber where they settle. Air is drawn out of this chamber by suction applied to the inside of a rotating sieve drum which filters off fibrous particles. These are removed by a roll carrying leather beating strips. Any fragments caught by the sieve are removed again by a plate whose edge almost touches the sieve surface.
K. RIDGWAY.

Herbicidal compositions. Monsanto Chemicals, Ltd. (Inventors: M. M. Baron and R. C. Tincknell) (B.P. 739,198, 30. 4. 54).—A chloro-

aryloxyalkylcarboxylic acid, e.g., 2 : 4-D is compounded (≮5% excess) with aliphatic or *cyclo*aliphatic amine in aq. medium, to give a cheaper herbicidal composition. F. R. BASFORD.

[Glycol] esters [of trichloroacetic acid]. B. F. Goodrich Co. (B.P. 738,626, 30.9.53. U.S., 31.10.52).—Mono- and di-esters of trichloroacetic acid with glycols or polyethylene glycols of mol. wt. 62—400, are prepared by refluxing 1—2 mol. of trichloroacetyl halide with 1 mol. of glycol for 6—8 hr. in toluene with azeotropic removal of the water produced. The monoesters are water-sol., but the diesters, which are sol. in hydrocarbons, require a dispersing agent for application as a water suspension. Dosages between 10 and 100 lb./acre are suggested for the suppression of different types of vegetation. H. C. WHITEHEAD.

2-Alkyl-3 : 4 : 5 : 6-tetrahydropyrimidinium nitrates and fungicidal compositions containing them. N.V. de Bataafsche Petroleum Maats. (B.P. 740,936, 14.8.53. U.S., 18.8.52).—Compounds, useful as foliage fungicides comprise nitrates of 2-alkyl (11—21, preferably 15—19 C) -3 : 4 : 5 : 6-tetrahydropyrimidines, optionally substituted in the 3-position by (NH_2- or OH-substituted)-alkyl of 1—3 C and by alkyl of 1—4 C in the 4-, 5-, and/or 6-positions. Thus, 4 : 4 : 6-trimethyl-2-heptadecyl-3 : 4 : 5 : 6-tetrahydropyrimidinium nitrate is compounded with Pr^iOH, machine oil η^{49} 95 sec. Saybolt, and emulsifier (aralkyl polyether alcohol), to provide a concentrate which with water (to give 0·04% of nitrate), affords a fungicidal spray, capable (100-150 gal. per acre) of controlling later blight (*Septoria apiigraveolentis*) on celery, etc. F. R. BASFORD.

Biocidal compositions. Monsanto Chemicals, Ltd. (Inventor: R. C. Tincknell) (B.P. 697,968, 9.8.50. Amended, 21.9.55).—An aq. pentachlorophenol (**I**) dispersion, which after application (to growing plants, etc.) leaves a residue resistant to rain, is prepared in presence of a dispersing agent (mahogany soap) used in conjunction with a volatile component (an alcohol, e.g., EtOH, Pr^iOH, butanol, *n*-pentanol, octanol or *cyclo*hexyl alcohol). Thus, a composition prepared from **I** (20), Dutrex 55 (commercial hydrocarbon oil, 50), Petronate (15) and *n*-butanol (15), is diluted with water (4000 pt.), and the resulting emulsion is applied to a convolvulus, to give thereon (after drying) a coating which is not washed off after 5 min. in running water. F. R. BASFORD.

Manufacture of octa-alkylprophosphoramides. Dow Chemical Co. (Inventor: H. Tolkmith) (B.P. 735,910, 18.3.53).—Compounds $O[PO(NR_2)_2]_2$, useful as pesticides, are obtained by heating $PO[O{\cdot}PO(NR_2)_2]_3$ (**I**) : (1 mol.) at >135° in presence of $PO(NR_2)_3$ (≮1 mol.) ; **I** is made by interaction of $XPO(NR_2)_2$ ≮3 with POY_3 1 mol. (R is alkyl of 1—4 C, X is Cl when Y is OR′ or is OR′ when Y is Cl, R′ is alkyl of 1—4 C). Thus a mixture of *tris(tetramethyldiamino-phosphoryl)phosphate* (d_4^{20} 1·2474, n_D^{20} 1·4685) 10 g. and $PO(NMe_2)_3$ 10·75 g. is heated during 5 hr. at 150°, then distilled to give *octamethylpyrophoramide*, b.p. 139—140°/1·5 mm., n_D^{25} 1·462. F. R. BASFORD.

Compositions for combating parasites. N.V. de Bataafsche Petroleum Maats. (B.P. 736,473, 23.9.53. Ger., 25.9.52).—A hydrazine derivative $NH_2{\cdot}CR{:}N{\cdot}NR'R''$ [R, R′ and R″ are H or (substituted) hydrocarbon radicals, or preferably R′ is H, R″ is (substituted) aryl or aralkyl, e.g., Ph, and R is CN or a CO-containing radical], is compounded with liquid or solid carrier, to provide a pesticidal composition. Thus, 68% suppression of *Phytophthora infestans* on potato plants is effected by spraying with an aq. solution of acetylamidrazone $[PhNH{\cdot}N{:}C(NH_2){\cdot}COMe]$ (0·5) and Triton X-100 (0·1%). F. R. BASFORD.

Bis-(ethylxanthoylthioxy)methylphosphine oxide [methyl *SS′*-bis-(ethoxythiocarbonyl)phosphonodithioate]. Dow Chemical Co. (Inventor: H. Tolkmith) (B.P. 736,579, 24.11.53).—The product named, of formula $MePO(S{\cdot}CS{\cdot}OEt)_2$, a viscous oil of n_D^{20} 1·4326, is made by interaction of ≮2 mol. of an alkali metal (Na) ethylxanthate with 1 mol. of methylphosphonic dichloride in an org. solvent (benzene) at 35—80°. The substance is an effective parasiticide for agricultural or household use, in the form of dusts or as dispersion of the finely-divided material in water or oil-in-water dispersions. H. L. WHITEHEAD.

Enrichment of animal feeds. Roche Products, Ltd. (B.P. 736,192, 20.8.53. Switz., 20.8.52).—Vitamin A (or its ester) is absorbed on a carrier [oatmeal, Ca casein, zein, MgO, $Mg(OH)_2$, $Ca_3(PO_4)_2$, soya-bean flour, or high-mol. fatty acid, amide, or partial ester (with a polyhydric alcohol)], then a non-aromatic primary amine (**I**) of ≮8 C and optionally gentisic aldehyde (or the condensation product thereof with **I**) are incorporated, together with antioxidant (ascorbyl palmitate or tocopherol), to provide a prep. suitable for enriching animal feed. F. R. BASFORD.

Increasing the starch content of raw fodder. N.V. Maats. tot Exploiteren van Octrooien en Licenties "Matepa" (B.P. 736,414, 16.7.52. Neth., 11.6.52).—The ensilage of protein-deficient raw fodder is effected by pulping, acidifying with any acid so that the mass is brought to pH 5, and storing in a silo which is sealed to prevent the access of oxygen. The starch already in the fodder is thus preserved from fermentative decomposition, and the crude fibre content lessened, since a part of it is converted to starch. Low-protein fodder is thus made of greater value as a feeding-stuff. K. RIDGWAY.

Working up of sewage sludge to obtain vitamin B_{12} and for the production of high-grade supplementary feeding stuffs.—APF products. Aschaffenburger Zellstoffwerke A.-G. (B.P. 740,941, 22.9.53. Ger., 22.9.52).—The sludge is digested in presence of a decomposition-promoting bacterial culture and optionally a Co salt, and is then heated at >100°. The total bulk is dried or the aq. solution is separated and concentrated, to give a product suitable for addition to animal feed. F. R. BASFORD.

Animal food compositions. International Minerals & Chemical Corp. (B.P. 738,679, 18.3.53. U.S., 27.3.52).—Glutamic acid solution pH 2·5—9, which has been produced from concentrated Steffen's filtrate or animal or vegetable protein, and from which (most of) the glutamic acid has been removed, is incorporated (0·1—25 wt.-%) into animal food, to give a more palatable composition. F. R. BASFORD.

2.—FOODS

Formation of bitter substances in cereals. M. Rothe (*Ernährungsforschung*, 1956, **1**, 165—168).—A review covering recent investigations. P. S. ARUP.

Sieving effect of bolting-silk at different relative atmospheric humidities. E. Anders (*Ernährungsforschung*, 1956, **1**, 196—201).—An increase in the R.H. from 40 to 90% reduces the sieving capacity of the material, owing to the swelling of the silk fibres. The effect is more pronounced with fine- than with coarse-mesh silk. Comparative experiments with metal-wire sieves reveal a further effect (in the same sense) of high R.H., due to the enlargement of the flour particles by adherence. P. S. ARUP.

Effects of treatment with chlorine dioxide on the properties of wheat flour. I. Chemical composition of protein of treated flours. P. Meredith, H. G. Sammons and A. C. Frazer. **II. Nutritional value of proteins of treated flours. III. Lipin changes and vitamin content of treated flours.** A. C. Frazer, J. R. Hickman, H. G. Sammons and M. Sharratt (*J. Sci. Food Agric.*, 1956, **7**, 361—370, 371—375, 375—380).—I. Ten times the normal level of ClO_2 in treatment of flour was used. Comparison was made with untreated and normally treated flours and with flour treated with ten times the normal amount of NCl_3. No abnormal substances were found in the treated or over-treated flours which were not present in the untreated material. Of the essential amino-acids only tryptophan was reduced in proportion >10% after heavy treatment with NCl_3. Of the non-essential amino-acids cystine was reduced to about 75% by heavy treatment with NCl_3 or ClO_2. (36 references.)

II. Feeding tests were made and wt. gains in relation to food intakes were studied, in rats given a diet containing 77% of breadcrumb, whether the flour was untreated or treated at ten times the normal level with ClO_2. Results indicated that treatment of flour with ClO_2 even at ten times the normal level has no demonstrable effect on the nutritional value of the flour proteins.

III. The palatability of the flour is affected by the development of rancidity of the flour lipins by air oxidation or by ClO_2 over-treatment, but alteration in nutritional value of the protein was not found. Vitamin-E activity was considerably reduced by treatment of the flour, but as this source is only ~10% of the total dietary vitamin E, it is not considered to be of nutritional significance to man. E. M. J.

Fate of labelled insecticide residues in food products. V. Nature and significance of ethylene dibromide residues in fumigated wheat. R. G. Bridges (*J. Sci. Food Agric.*, 1956, **7**, 305—313).—Using ethylene dibromide labelled with ^{82}Br under the conditions of fumigation of wheat and of subsequent airing and drying, some decomposition of the ethylene dibromide to ethylene glycol occurs on heating imperfectly aired wheat and the glycol may react with the $-SCH_3$ of the methionine residues of the wheat protein. Liberated HBr may cause splitting of the starch granule sheaths. Nutritional and toxicological significance of fumigation are discussed. (34 references.) E. M. J.

Desorption isotherms of wheat at 25 and 50°. H. A. Becker and H. R. Sallans (*Cereal Chem.*, 1956, **33**, 79—91).—The differential net heat of desorption (heat required to remove one mol. of water from an infinitely large wt. of adsorbent), calculated from the desorption isotherms for wheat at 25 and 50°, is initially ~7—10 kg.-cal.,

becoming negligible in comparison with the normal heat of vaporisation of water at moistures ⩾30% dry basis. The total heat of dehydration is ~43—47 g.-cal. per g. of wheat, calculated on a dry-matter basis. The average values of the net heat of desorption to be used in drying calculations have been computed. The heat evolved when a drying wheat kernel is allowed to shift from non-uniform to uniform moisture distribution at constant average moisture content has been evaluated. (11 references.)
S. C. JOLLY.

New method of fractionating wheat flour. W. F. Sollars (*Cereal Chem.*, 1956, **33**, 111—120).—Wheat flours may be fractionated by a method which compares favourably with separations involving doughing and kneading under water. The water-sol. fraction is first obtained by extracting the flour with water, and the gluten by extracting the residue with dil. acetic acid and neutralising the extract. The final residue is then separated into tailings and pure starch. Acid extraction at pH 2 was most efficient, but cookies prepared from reconstituted flours were of better quality when pH ⩽3 was used. Because the acid extraction procedure is relatively slow, it is particularly recommended for fractionating low-protein flours or those with damaged gluten. (14 references.)
S. C. JOLLY.

Evaluation of flour fractions for their importance to cookie quality. W. F. Sollars (*Cereal Chem.*, 1956, **33**, 121—128).—When reconstituted into flour suitable for baking cookies, the tailings fraction obtained from acid-fractionation of wheat flours of varying quality (see previous abstract) had far greater effect on cookie diameter (**I**) than had the water-sol., gluten and prime starch fractions and is apparently the most important fraction in cookie quality. Water solubles had a small but consistent effect on **I**, but because the amount of this fraction was small the effect was relatively large per g. of material. The effect of gluten was erratic and difficult to assess. (10 references.)
S. C. JOLLY.

Physical nature of gliadin. J. Holme (*Dissert. Abstr.*, 1955, **15**, 2398).—The physical nature of the wheat prolamine, gliadin (**I**), was studied, including the electrophoretic patterns and the effect upon them of pH, ionic strength, buffer ion type, and hydrogen bond reagent concentration; the particle size heterogeneity determined by ultracentrifugation and light-scattering measurements, and the solubility and cohesive properties. The electrophoresis results are compared with those obtained for bovine plasma albumin and ovalbumin and for solutions containing polymethacrylamide (**II**) with hydrolysed **II**; **II** with hydrolysed **I**; and **II** with casein.
O. M. WHITTON.

Carbohydrates of wheat. J. Carles (*C. R. Acad. Sci., Paris*, 1955, **241**, 1329—1331).—Paper chromatographic techniques are described for separating wheat carbohydrates, which are shown to accumulate in two forms—monoglucofructoholosides, which are ephemeral, and starch, which is stable. Starch is accompanied by raffinose and, eventually, maltose. The fructoholosides contain predominant amounts of trihexose (glucose + two fructose units) and higher saccharides.
J. S. C.

Effect of sucrose on the properties of some starches and flours. E. E. Hester, A. M. Briant and C. J. Personius (*Cereal Chem.*, 1956, **33**, 91—101).—Addition of sucrose (15·9—39·5 g. per 100 g. of water) to pastes and gels of maize and wheat starches and wheat flours and to pastes of non-gelling waxy-maize starch inhibited hydration of the starch granules. The max. and final η of wheat flour pastes were markedly increased by heating with sucrose, and the gels tended to be firmer; comparable pastes of wheat starch showed no max. η and little or no change in final η, and the gels were weakened. The influence of sucrose on constituents of flour other than starch is apparently responsible for the effects on paste and gel properties.
S. C. JOLLY.

Small-scale dough mixer for use in wheat quality work. H. Miller, J. Edgar and A. G. O. Whiteside (*Cereal Chem.*, 1956, **33**, 136—140).—The vertical conical mixer described is based on a light kitchen-type mixer and is capable of mixing a 5-g. dough in ⩾1 min. The bowl has a temp.-controlled base to prevent chilling of the dough which can be observed during mixing.
S. C. JOLLY.

Semimicro baking procedure, with mechanical dough handling, primarily designed for evaluation of additives. M. A. Cookson and M. L. Ritchie (*Cereal Chem.*, 1956, **33**, 102—110).—A partly mechanised method of test baking is described in which three loaves are made from a bulk dough prepared from 250 g. of flour, thus allowing bread storage tests to be carried out on small samples of flour in addition to the usual assessments of fresh-loaf characteristics. (10 references.)
S. C. JOLLY.

Improved media and methods for the estimation of infecting organisms in baker's yeast. J. D. Levi (*J. Inst. Brew.*, 1956, **62**, [New Series **53**] 261—264).—Two new media based on xylose and succinic acid respectively, used for the estimation of *Oospora lactis* in baker's yeast and the use of an assay frame of 12-in. diameter on which 1—10 g. of yeast can be plated are described. The medium containing NH_4 succinate–mineral salts–agar is useful for tracing wild yeast infections. For estimating *O. lactis* in large samples of yeast (120 g.), NH_4 succinate–mineral salts–broth gives fairly consistent results.
E. M. J.

Question as to covering of requirements of bread-vitamins. B. Thomas (*Ernährungsforschung*, 1956, **1**, 105—111).—Dietary investigations indicate inadequacies in supplies of vitamins B_1 and B_2 and of nicotinamide, especially in the case of manual workers. Vitamin fortification of bread-flour is recommended. The advantages, in this respect, of whole-meal products are pointed out.
P. S. ARUP.

Occurrence of acetoin and diacetyl in ropy bread. K. Täufel and R. Pohloudek-Fabini (*Z. LebensmittUntersuch.*, 1956, **103**, 430—437).—In experimental prep. acetoin and diacetyl occurred as natural constituents of wheat bread, the contents depending on a series of factors; storage causes an increase. In samples of freshly prepared dough, with and without inoculation with *Bacillus mesentericus*, both indicated rise in values of acetoin and diacetyl, especially of acetoin. Neither substance was present in the wheatmeal and yeast used; citric acid was present in wheatmeal 21·55 and in yeast 292 mg. per 100 g. While the dough was rising a small portion of acetoin, but no diacetyl was produced; there was a decrease in citric acid. With the development of ropy bread the contents of acetoin and diacetyl rise rapidly; citric acid content falls, but no significant relationship was noted between these two factors.
E. M. J.

Characteristics of shortened cake baked in a fast- and a slow-baking pan at different oven temperatures. H. Charley (*Food Res.*, 1956, **21**, 302—305).—The baking time was 27 min. for cakes baked in a japanned iron pan (**I**) at 345°F. and in a tinned iron pan (**II**) at 365°F.; 24 min. for cakes baked in **I** at 365°F. and in **II** at 395°F. Temp. adjustments tested failed to compensate for the effects on shortened cake of the baking pan material.
E. M. J.

Production of furfural from agricultural waste products and plant material. A. A. Shcherbakov and Yu. K. Yur'ev (*Zh. prikl. Khim.*, 1956, **29**, 110—118).—The pentosan contents of some plant products are: bean stalks 13·9, pods 15·0, radish stalks 17·7, pods 17·4, seeds 6·0, chestnut shells 11·7, kernels 5·0, rapeseed residues 19·0, potato stalks 23·8, tomato stalks 24·4, marrow stalks 11·7, esparcet stems 13·5, pumpkin seed hulls 14·4, walnut shells 19·4, hazel nut shells 23·5, maize cobs 38·6—41·1, barleyseed hulls 29·2, oat straw 31·2, sunflower seed hulls 26·1, buckwheat hulls 26·2, millet hulls 20·2, peat 7·8—15·4% of dry content. The yields of furfural are raised by about 25% by mixing the plant material with 25% of its wt. of $CHCl_3$ before starting hydrolysis. (21 references.)
R. TRUSCOE.

Distribution, formation and utilisation of raffinose and stachyose in seeds. R. Duperon (*C. R. Acad. Sci., Paris*, 1955, **241**, 1817—1819).—Carbohydrates in the seeds of 81 species of mono- and dicotyledons were identified by paper chromatography. Saccharose was present in all and raffinose in 70 species. Stachyose was less common. The two former holosides form during maturation of seeds and are utilised in the first days of germination.
J. S. C.

Sorbitol in *Rosaceæ* V. Plouvier (*C. R. Acad. Sci., Paris*, 1955, **241**, 1220—1222).—Sorbitol was extracted from the stems or fruits of *Rosaceæ* by a method previously described for the methyl ethers of inositols (*ibid.*, 1947, **224**, 1842; 1948, **227**, 85, 225) and was isolated, either in pure form or as the hexa-acetyl derivative, from all the *Spiræoideæ*, *Pomoideæ* and *Prunoideæ* examined, and from *Rhodotypos*, *Kerria* and *Neviusia* (a total of 30 genera and 55 species). It was not found in the *Rosoideæ* which contain sucrose.
J. S. C.

Hydrolysis and reversion of saccharides. K. Täufel and K. Müller (*Ernährungsforschung*, 1956, **1**, 90—95).—A review of conditions (mainly sugar concn.) favouring reversal (or non-reversal) of the hydrolysis (mainly by acids) of polysaccharides, and their significance in carbohydrate technology and analysis.
P. S. ARUP.

Gummy substances in Taiwan cane molasses. I. Precipitation at various pH and identification of the sugars and amino-acids by paper chromatography. P. T. Hsieh, Y. H. Liau and Y. L. Yow (*J. Chinese chem. Soc.*, 1955, **II, 2**, 154—162).—The effect of pH (1·5—6·8) on the amount and composition of the gum pptd. by addition of EtOH to the molasses was studied, and the carbohydrates and amino-acids in the hydrolysate of the gum obtained at pH 1·5 were separated and identified (where possible) by two-dimensional paper chromatography. At pH >4·8 there is formed initially an emulsion which gives a ppt. only after 1—2 days. The amount of ppt. increases rapidly with pH, as do the % (based on molasses solid) of ash, N compounds, pentosans, polysaccharides and reducing substances but, based on gum substance, these % decrease with rising

pH except for N compounds (which remain approx. const.) and for reducing substances (which increase slightly). Arabinose, galactose, xylose, uronic acid and its Ba salt are present in the acid hydrolysate examined, as well as glutamic acid, cysteine, glycine, lysine, histidine, arginine, alanine, valine, leucine, aspartic acid and eight other unidentifiable amino-acids. W. J. BAKER.

Ion-exchange electrodialysis for demineralisation of sugar solutions. Agnes M. Anderson and C. B. Wylam (*Chem. & Ind.*, 1956, 191—192).—Experiments with grass extracts, using ion-exchange membranes in an electrodialysis cell, show that effective demineralisation with complete recovery of sugars can be secured by this technique. (10 references.) J. S. C.

Applications of paper chromatography to the sugars. J. Moreno Calvo and A. Santos-Ruiz (*Rev. esp. Fisiol.*, 1955, **11**, 225—252).—A study was made of the chromatographic separation of sugars using a mixed solvent of ethyl acetate–pyridine–water. The following are discussed: results on seven sugars separated; the separation of the sugars of natural mixtures (wines, juices of different fruits, milk, etc.) without purifying the extracts, and in the presence of inorg. ions or boric acid; the separation of amino-acids and the natural proteins; the distinction between the enzyme actions of α- and β-amylases and the control of inhibition of these enzymes. (37 references.) E. M. J.

Determination of glucose, maltose and other fermentable oligosaccharides as well as of dextrins after addition of culture yeast. K. Täufel and K. Müller (*Z. LebensmittUntersuch.*, 1956, **103**, 272—284).—A critical survey of the methods of biological determination and differentiation of saccharides is given. A short decomposition method is described depending on the work of Pan *et al.* in which glucose can be fermented in 15 min., maltose in 2 hr., and other fermentable oligosaccharides (isomaltose, maltotriose and panose) within 6 hr. Starch hydrolysates, e.g., of starch syrup are used and the constitutional linkages of four groups of substances glucose, maltose, other fermentable oligosaccharides and dextrin can be studied. The method gives results in good agreement with those of the standard fermentation method (48 hr.) and is very suitable for the determination of dextrin. (38 references.) E. M. J.

Volatile compounds produced by apples. I. Aldehydes and ketones. D. F. Meigh (*J. Sci. Food Agric.*, 1956, **7**, 396—410).—A method is described for the collection of volatile compounds from the air above apples in cold storage at 38—39°F. Carbonyl compounds present were converted into 2 : 4-dinitrophenylhydrazones, separated by paper chromatography and identified by a u.v. spectroscopy. The main constituent was acetone, with smaller amounts of acetaldehyde, *n*-butanal, propanal, etc. There was no correlation between high rate of carbonyl evolution and heavy incidence of scald. (20 references.) E. M. J.

Microscopical structure of apricot purees. R. M. Reeve (*Food Res.*, 1956, **21**, 329—336).—Comparison of the structure of apricot purees of different manufacture, sampling methods and classification of the particles as to size, shape and fruit tissue origins are discussed. E. M. J.

Anthocyanin pigments of sour cherries. Kuang C. Li and A. C. Wagenknecht (*J. Amer. chem. Soc.*, 1956, **78**, 979—980).—Antirrhinin and mecocyanin are isolated from sour cherries. The crude pigments are obtained through their Pb salts and separated by chromatography on silicic acid. The pigments are identified by paper chromatography, colour reactions, absorption spectra and comparison with synthetic specimens. (17 references.) M. DAVIS.

Change of taste of persimmon during ripening. M. Tsujimura, T. Yamanishi, S. Takemoto and H. Nemoto (*Nat. Sci. Rep. Ochanomizu Univ.*, 1955, **6**, 111—117).—Two kinds of persimmon were studied in an attempt to correlate sugar and tannin contents with taste. The Hachiya (astringent) and Fuyuu (sweet) types are both astringent in taste when green. On ripening Fuyuu loses astringency and becomes sweet, whereas Hachiya remains astringent. Various analytical procedures, including paper chromatography, were applied to determine sugars and tannins and it is concluded that the difference between the two kinds is explained by the change of soluble to insoluble tannin in Fuyuu during ripening and is not due to any difference of sugar content. J. S. .C.

Dispatch of bananas in polyethylene [foil]. W. Spoon (*Plastica*, 1956, **9**, 142).—A method for packing the banana clusters in perforated plastic foil is described, whereby each cluster is separately encased (by heat-sealing) in such a way that it can be suspended by the twisted upper end of the casing foil. On arrival, the packed clusters are separately suspended in the ripening-store. P. S. ARUP.

Problems concerning citric acid in food- and technological-chemistry. K. Täufel (*Ernährungsforschung*, 1956, **1**, 79—84).—The importance of citric acid in microbiological, plant, and animal metabolism is pointed out, and new prospects for research in this field are suggested. P. S. ARUP.

Effect of chemical additives on the production of citric acid by *Aspergillus niger*. Nganshou Wai (*J. Chinese chem. Soc.*, 1955, **II**, **2**, 163—167).—The production of citric acid by fermentation (*A. niger*) of a solution containing sucrose, NH_4NO_3, KH_2PO_4 and $MgSO_4$ can be accelerated by addition of 1—2 p.p.m. of camphor, or 10—20 p.p.m. of $ZuSO_4$ or β-indolylacetic acid. In favourable conditions, 46—55% of sucrose is converted after 28 days at 23—25°. The effect of other metal salts, NH_2CO_2Et and MeOH is either negligible or inhibitory. W. J. BAKER.

Changes in ascorbic acid content of orange juice during concentration and conversion into powder. G. S. Siddappa, B. S. Bhatia and G. Lal (*J. sci. industr. Res.*, 1956, **15C**, 28—32).—The juice of three varieties of Indian orange has been concentrated and converted into powder. A method for the prep. has been standardised in order to preserve the ascorbic acid content as far as possible. The retention of the vitamin in the three varieties concentrated to 72° Brix. *in vacuo* at 50—52° is 85—90%. If the concentrate is stored at 24—30° there is a rapid loss, minimised at 2—5°, of vitamin C. A further loss of 31—57% of ascorbic acid occurs during the preparation of powder if a vacuum shelf drier is employed, but with an ordinary shelf drier the whole vitamin content is lost. C. A. SLATER.

Aspects of numerical scoring in subjective evaluation of foods. A. F. Carlin, O. Kempthorne and J. Gordon (*Food Res.*, 1956, **21**, 273—281).—Using scales of 0—5, 0—10 and 0—100 on reconstituted orange juice with three levels of added sugar, the 0—100 scale is as good as the 0—5 scale and in some cases was better. The mean score given to the intermediate level of added sugar samples was affected by the order of presentation. Scoring by paired test gave consistent results. E. M. J.

Nutritional value of fruit juices. V. L. S. Charley (*Proc. Symp. nutr. Aspects of preserved Food, Swed. Inst. Fd Preservation Res.*, 1954 [1956], 115—122).—Analytical data relating to nutritional constituents (total sugars, acids, minerals and ascorbic acid) in pure fruit juices from tropical and temperate fruits and to fruit juice syrups with stabilised and guaranteed ascorbic acid contents are discussed. The effect on health of administering blackcurrant syrup for long periods is reviewed. S. C. JOLLY.

Effect of canning on the nutritive value of fruit and vegetables. W. B. Adam (*Proc. Symp. nutr. Aspect of preserved Food, Swed. Inst. Fd Preservation Res.*, 1954 [1956], 41—58).—The loss of ascorbic acid from fruits and of ascorbic acid, thiamine, riboflavin, nicotinic acid and carotene from vegetables during various stages in canning and subsequent storage and serving are reviewed. Charts are given of the contents of the various vitamins etc. in a number of fruits and vegetables. (30 references.) S. C. JOLLY.

Causes of discoloration in steamed potatoes. III. Significance of steaming time, temperature and enzymes present. F. Kiermeier, E. Rickerl and Kamarijani (*Z. LebensmittUntersuch.*, 1956, **103**, 285—290).—Proof that darkening of steamed potatoes is caused by enzyme action is not available. It is more probable that a still unknown acceptor in the potato takes part in the reaction between Fe^{++} and chlorogenic acid. This acid, found in six varieties of potato, was first set free on heating the potato above 80°. (28 references.) E. M. J.

Potato flakes, a new form of dehydrated mashed potatoes. M. J. Willard, jun., J. Cording, jun., R. K. Eskew, P. W. Edwards and J. F. Sullivan (*Amer. Potato J.*, 1956, **33**, 28—31).—The production of potato flakes in a pilot plant is described. A. H. CORNFIELD.

Flavour of dehydrated potatoes made from material treated with tetrachloronitrobenzene. E. G. B. Gooding, C. G. Tucker and J. M. Harries (*J. Sci. Food Agric.*, 1956, **7**, 411—416).—Treatment of raw potatoes with technical grade tetrachloronitrobenzene (10 lb. of the 3% dust per ton of potatoes) resulted in a taint in the dehydrated product and was strongest in material that had least leaching during processing. The taint increased with the period of storage, 10 or 26 weeks, or 12—16 weeks, of the raw potatoes. E. M. J.

Effect of post-harvest storage conditions of raw potatoes on the storage life (at tropical temperatures) of their dehydrated products. E. G. B. Gooding, R. B. Duckworth and J. M. Harries (*J. Sci. Food Agric.*, 1956, **7**, 444—456).—High reducing sugar content in the raw potato diminishes the life of the dehydrated product when stored at high temp. Potatoes stored in a field clamp after a spell of cold winter weather halved the storage life of the dehydrated product when held at 98·6°F. Conditioning of the tubers after the cold spell for 2—3 weeks at 60°F. before dehydration diminished the content of reducing sugars. Potatoes which had been treated with a sprout

depressant and stored in a shed at a min. temp. of 43°F. had lowest reducing sugar contents and gave dehydrated products most resistant to high temp. storage. E. M. J.

Different states of combination of water in potato starch. M. Ulmann (*Ernährungsforschung*, 1956, **1**, 96—104).—The course of the loss of water by i.r. heating of the starch is followed by means of a device embodying a sensitive pointer-balance (of the letter-balance type) which is actuated through a lever-system carrying the drying-dish. The initial loss of adsorbed water follows a course similar to that observed when water is placed in the drying-dish, after which breaks in the drying-curve indicate the presence of water in $\lessdot 3$ states of combination of progressive stability. P. S. ARUP.

Applicability and efficiency of alumina chromatography of potato starch. M. Ulmann (*Ernährungsforschung*, 1956, **1**, 152—161).—The technique described consists in the passing (by suction) of the dil. starch solution through a column of moist Al_2O_3, and following up with 0·0025N-I in aq. KI. Under these conditions, a blue zone, given by amylose, appears at the top, and a violet zone, given by the amylopectins, in the lower part of the column. The establishment of a range of pH in the column, varying from 4·5 at the top to 8·0 at the bottom, by the addition of a limited amount of 0·02% HCl has the effect of reversing the positions of the amylose and amylopectin bands in the column, and also of giving a more detailed subdivision of intermediate zones. Examples of the applicability of this technique are quoted from the author's published results, which include the following observations: the amylose and the amylopectin fractions of potato starch are generally separable into well-defined zones with no indications of transitional forms. Various effects can be observed in the chromatograms, which depend on the method of prep. of the starch solutions or the method used for the separation of the amylose and amylopectin fractions. On acid or diastatic hydrolysis of potato starch, the amylose is more resistant than the amylopectins, but diastatic hydrolysis is distinguished from acid hydrolysis by the early appearance of dextrin-complexes which are indicated by brown bands in the chromatogram. P. S. ARUP.

Characterisation of phytin in peas. H. D. Fowler (*J. Sci. Food Agric.*, 1956, **7**, 281—287).—Phytin extracted from peas by a method depending on its insolubility in hot 8% acetic acid was characterised by paper chromatographic method and found to be a pure compound giving C : H : P ratios of 1 : 4 : 1 consistent with the formula of a hexaphosphate. A comparison of pea phytin with commercial and synthetic Ca phytate, by paper chromatographic separation indicated that commercial phytin is composed of two org. phosphates (in addition to orthophosphate) one of which resembles pea phytin. (16 references.) E. M. J.

Rapid method for the determination of total solids in tomatoes. A. F. Mabrouk, A. A. Hussein and H. Aref (*J. Sci. Food Agric.*, 1956, **7**, 257—261).—Data are presented on the relation of the refractive index to total solids content of tomatoes grown in Egypt, having a sugar content of 46% of the total solids, compared with ~50% in American tomatoes. An equation was derived: total solids in wt.-% $= 522{\cdot}60n_D - 695{\cdot}26$. E. M. J.

Sorbic acid as a selective agent in cucumber fermentations. I. Effect of sorbic acid on micro-organisms associated with cucumber fermentation. R. N. Costilow, W. E. Ferguson and S. Ray (*Appl. Microbiol.*, 1955, **3**, 341—345).—The activity of yeasts on a vegetable juice-agar medium of pH <5 was inhibited by sorbic acid, the min. proportion required for complete inhibition varying from 0·04 to 0·01 as the salt content of the medium was increased from 0 to 8%. *Pediococcus cerevisiæ*, *Lactobacillus plantarum* and *L. brevis* were not affected appreciably by sorbic acid regardless of pH. None of the organisms examined acted on sorbic acid. A. G. POLLARD.

New methods for cooking vegetables or potatoes at temperatures (partly) below 100°c. M. Zobel and G. Schramm (*Ernährungsforschung*, 1956, **1**, 186—195).—Temp. $<100°$ (e.g. 70—80°) suffice for the prep. of vegetables, celery, carrots, white cabbage or potatoes in satisfactory condition. On this basis, a method is proposed which consists in heating to the b.p., maintaining the boiling temp. (with reduced fuel or power consumption) for a limited time (10 min. suffices for potatoes), discontinuing the heating, and then allowing the saucepan and contents to stand for a certain time (15 min. for potatoes). The method succeeds best with the use of cooking vessels (with lids) of $\lessdot 1{\cdot}5$-l. capacity. Directions are given for the treatment (including the proportions of water to vegetables) of several vegetables. With the use of electric heating, the boiling-time can be shortened. Besides savings in fuel or power and cooking-space, the method offers the advantage of reduced losses of vitamin C and salts of K and Fe in potatoes. P. S. ARUP.

Thermal destruction of peroxidase in vegetables at high temperatures. W. B. Esselen and E. E. Anderson (*Food Res.*, 1956, **21**, 322—325).—A survey was made of the comparative heat resistance of peroxidase in 17 fresh vegetables in the temp. range of 215 to 300°F. by means of a thermoresistometer. To prevent regeneration of enzyme activity during subsequent storage, 2—4 times greater degree of heat was required to destroy the enzyme, on a basis of tests made immediately after heating. The peroxidase in vegetables had generally high z values as compared with those for bacterial spores. E. M. J.

Effect of sunlight on crude lipins extracted from fresh and frozen vegetables. F. A. Lee (*Food Res.*, 1956, **21**, 254—263).—Crude lipins extracted from raw vegetables gave a more rapid increase in peroxide no. than did those extracted from corresponding blanched samples after varying periods of exposure to sunlight (10,000 foot candles intensity) except in lima beans. Absorption spectra of the samples were determined. E. M. J.

Deep fat frying of cashew kernels. M. Prasad and P. B. Mathur (*Food Res.*, 1956, **21**, 306—311).—Collected data indicate that the optimum conditions for deep-fat frying of cashew kernels are 180° for 80 sec.; % of moisture lost during frying increased, but % of gain in wt. of kernels at the end of frying decreased with increased durations of frying. Deterioration of the frying media was greater in the case of groundnut oil compared with vanaspati. E. M. J.

Non-thermal drying of brown marine algæ. K. C. Reid and P. Jackson (*J. Sci. Food Agric.*, 1956, **7**, 291—300).—Air drying of *Ascophyllum nodosum*, the predominating littoral seaweed of Britain, and of the stipes of the sub-littoral *Laminaria cloustoni* to about 50% (wet basis) of original water content, may be achieved on an inclined grid which allows passage of wind through and drainage of water from the seaweed. Centrifuges or screw expellers remove 40 and 60% respectively of water, but this carries a significant proportion of sol. solids. Plasmolysis is not practicable although technically feasible. E. M. J.

Practical experience with the Garoglio-Stella method for detection of traces of sucrose in must and wine. B. Weger (*Mitt. Wein-u. Obstbau, Wien*, 1956, **6A**, 25—29).—The min. amount of sucrose detectable by this method (cf. *ibid.*, 1955, **5A**, 282) is 0·04, not (as claimed) 0·01—0·02%. The distinction between sucrose and invert sugar by means of the proposed colour-reaction is unreliable. P. S. ARUP.

Sulphurisation experiments with short-time high-temperature heating of grape-musts and the wines produced therefrom. F. Paul (*Mitt. Wein- u. Obstbau, Wien*, 1956, **6A**, 34—48).—The consumption of SO_2 by musts or the corresponding wines is not appreciably altered by heating the musts in plate-heaters at 85—90° during 2 min. The results indicate that this method of pasteurisation coupled with reduced additions of SO_2 would be advantageous, provided that true SO_2 requirements could be determined more precisely than is possible by the analytical methods employed. (12 references.) P. S. ARUP.

Effect of improvement of must on quality and chemical composition of wine. F. Prillinger (*Mitt. Wein- u. Obstbau, Wien*, 1956, **6A**, 48—63).—Increased EtOH contents due to added (dry) sugar reduce (slightly) the alkalinity and ash content of the wine, but do not appreciably affect values for extract less sugar and acid. Several modified formulæ are given for calculating EtOH contents in fermented sugar-fortified musts. The connexions between fermentative changes, must-turbidity and glycerol content are discussed. Deacidification by addition to the must of $CaCO_3$ precipitates most of the tartaric acid (if present in large amount) without detriment to flavour. Delayed pptn. of Ca tartrate can, however, cause large increases in alkalinity and ash content. Buffering with $CaCO_3$ greatly improves the acid flavour of the wine. Practical measures are proposed for retaining this acid flavour by preventing biological decomposition and limiting deacidification to chemical pptn. P. S. ARUP.

Modern chemical purification procedure in the brewing industry. O. Grossholz and W. Hess (*Schweiz. Brauerei Rdsch.*, 1956, **67**, 92—96).—Problems encountered in the brewing industry and their control are reviewed, including the deposition of mineral salts from the brewing waters, $CaCO_3$ and its removal by acids; and removal of $CaCO_3$, $CaSO_4$, etc. deposits throughout the whole plant. E. M. J.

Fuel oil and its combustion. Anon. (*Brauerei-techniker*, 1956, **8**, 89—92).—A review covering German standards for fuel oils, problems of conversion to fuel oil heating in breweries, and conditions for efficient combustion. P. S. ARUP.

Brewery effluents and their purification. A. Kaess (*Brauerei-techniker*, 1956, **8**, 98—101).—A review covering the characteristics of various types of effluents, and methods for their purification, with special reference to brewery effluents. P. S. ARUP.

Enzymes that degrade barley gums. IV. Varietal differences in endo-β-polyglucosidase activity. E. J. Bass and W. O. S. Meredith (*Cereal Chem.*, 1956, **33**, 129—135).—For green malts from nine barley varieties of varying malting quality, high cytolytic activities were associated with satisfactory malting properties and vice versa, except with one variety (Br. 3833) which produced a high-quality malt despite having a significantly substandard activity. The enzyme assay cannot be considered reliable for quality prediction and control until this anomaly is resolved. (12 references.)

S. C. JOLLY.

Analysis of barley proteins. E. Waldschmidt-Leitz and H. Brutscheck (*Brauwissenschaft.*, 1955, 278—282).—A complete analysis of barley proteins was carried out by the latest methods, including chromatography and electrophoresis. The barley protein fractions were prepared after the method of Osborne (*J. Amer. chem. Soc.*, 1895, **17**, 539), and then hydrolysed in presence of $SnCl_2$ in a closed tube heated to 110° for 24 hr. The amino-acids so formed were separated by the method of Stein and Moore (*J. biol. Chem.*, 1948, **176**, 337; 1949, **178**, 53). The amino-acid content of the four main barley proteins are reported, as well as those of the various cereal prolamines, and the chill haze of beer. It is concluded that the insoluble chill haze of beer consisted mainly of a peptide which is formed by the hydrolysis of the hordein. The relationships of protein composition to barley type are discussed.

G. H. BAKER.

Carbohydrates in malting and brewing. III. Modified method for determining carbohydrates by means of the anthrone reagent. R. D. Hall. **IV. Determination of starch in barley and malt.** I. C. MacWilliam, R. D. Hall and G. Harris. **V. Further studies on the carbohydrates of barley, malt and wort.** R. D. Hall, G. Harris and I. C. MacWilliam (*J. Inst. Brew.*, 1956, **62**, [New Series **53**] 222—226, 226—231, 232—238; cf. J.S.F.A. Abstr., 1956, i, 166).—III. Factors which affect the precision of the described modified method for determining carbohydrates are discussed. When the sugar solution (e.g., in estimating the small amount of fructose found in malt) is frozen in a mixture of solid CO_2 and methanol, anthrone–H_2SO_4 reagent added, the mixture shaken as the temp. rises to 15°, and the whole heated in a water bath at 90° for 14 min., highly reproducible colours are developed. (26 references.)

IV. From a survey of various methods the most satisfactory procedure for determining starch involves (*a*) preliminary extraction of simpler carbohydrates, (*b*) solution of the starch with aq. perchloric acid, (*c*) pptn. with I and (*d*) estimation with anthrone–H_2SO_4 reagent. (33 references.)

V. Studies on Plumage-Archer variety of barley grown in 1951 and on Carlsberg barley, 1953 crop, are discussed, including changes of quantity of starch during malting and increase in capacity to combine with I. The results on the Carlsberg barley are in general agreement with those of the earlier work. By comparing the composition of the malt with that of the corresponding wort nearly the whole of the potentially available extract of the grain is utilised during mashing. (18 references.) E. M. J.

Apparatus for evaluation of the degree of modification of malts: the Sclerometer. H. Beck (*Brasserie*, 1955, **10**, 249—262; 1956, **11**, 15—28, 57—66).—The mechanisms of the germination of barley and a concept of "disaggregation" (modification) are defined and existing methods of evaluation are discussed. The "Sclerometer" is described, which is based on the principle of determining the min. force necessary to rupture the kernel of an individual grain. The statistical and mathematical interpretation of results obtained with the apparatus is developed and it is shown that "disaggregation" of a malt sample can be completely defined in terms of two parameters—mean hardness and coeff. of dispersion. Experimental results obtained with the apparatus are examined in respect of reproducibility and compared with results obtained by the use of the diaphanoscope and by plumule growth measurement. The effects of duration of germination and of steeping, of homogeneity and heterogeneity in malts, and the use of the apparatus to study varietal differences, are also discussed. J. S. C.

Nitrogenous constituents of brewing materials. VIII. Fractionation of the nitrogen compounds of worts and beers. Foam-stabilising activity of the fractions. J. W. Davies, G. Harris, S. Jackson and R. Parsons (*J. Inst. Brew.*, 1956, **62**, [New Series **53**] 239—250; cf. J.S.F.A. Abstr., 1956, i, 322).—Modifications of the alcohol–metal salt fractionation method of Cohn *et al.* were applied to worts and beers to yield concentrates of proteins and polypeptides in quant. and reproducible fashion. The various protein fractions were mixtures, and in addition, contained polysaccharide; they represented the bulk of the undialysable N of the original worts and beers; they contained the bulk of the foam-stabilising activity. The solution after removal of the ppt. contained only a small proportion of undialysable N compounds and was submitted to ion-exchange procedures. (20 references.) E. M. J.

Fermentation velocity of yeast as a factor controlling attenuation in top fermentations. N. S. Curtis and A. G. Clark (*J. Inst. Brew.*, 1956, **62**, [New Series **53**] 256—261).—No relationship was found between the N content of the yeast crop and therefore the fermentation velocity of the yeast in the fermenting wort, and attenuation at rack either for the strain of flocculent or of non-flocculent yeast examined. Poorly attenuative yeasts of high generation no. are not associated with a lower N content than that of more powerfully attenuated yeast of lower generation no. E. M. J.

Digestibility *in vitro* of brewery and sulphite-liquor [food-] yeasts. H. Klaushofer and A. Schaller (*Mitt. VersSta. Gärungsgew.*, 1956, **10**, 43—51).—Methods for the prep. of food-yeasts are reviewed. The peptic and tryptic digestibilities of two brewery and one sulphite-liquor yeast are determined by five known *in vitro* methods. Most of the results obtained show poor agreement with feeding results obtained by other workers for food-yeasts of similar origin. The enhanced production of sol. N caused by the presence of $Na_2B_4O_7$ in the digestion mixture is not connected with purine decomposition. (71 references.) P. S. ARUP.

Development of resins during the ripening of hops. G. A. Howard and A. R. Tatchell (*J. Inst. Brew.*, 1956, **62**, [New Series **53**] 251—256).—During ripening of hops the α- and β-acids appear simultaneously 5—6 weeks before picking. Of the individual constituents of the resins, cohumulone, humulone, adhumulone, colupulone, lupulone and adlupulone are all present from the earliest stage examined. In the early stages the proportions of cohumulone in the α-acids and of colupulone in the β-acids are lower than those characteristic of the variety, but they increase to the expected levels before the hops are ripe. (14 references.) E. M. J.

Leuco-anthocyanins of unprocessed tea leaf. E. A. H. Roberts, R. A. Cartwright and D. J. Wood (*J. Sci. Food Agric.*, 1956, **7**, 253—257).—Paper chromatograms of unprocessed tea-leaf indicate the presence of a relatively large no. of minor polyphenolic components some of which have been provisionally identified as leuco-anthocyanins, but not yet isolated. Most of the leuco-anthocyanins are leuco-delphinidins, but a leuco-delphinidin and a leuco-cyanidin can be non-separable on paper chromatograms. An unidentified polyphenol, giving an orange colour reaction with $AlCl_3$, also occurs in some sources of tea-leaf and overlaps one of the leuco-anthocyanin spots on paper chromatograms. Structural formulæ are considered. (13 references.) E. M. J.

Utilisation of the nitrogenous compounds in milk by lactic acid bacteria. Homer W. Walker (*Dissert. Abstr.*, 1956, **16**, 211).—The utilisation of individual nitrogen constituents of milk by cultures of lactic organisms, and the effect of pasteurisation and autoclaving of the proteins on the growth of these organisms were studied. No single compound was found to be the chief N source for the organisms.

O. M. WHITTON.

Nutritional efficiency of dehydrated milk. K. Dürrenmatt (*Proc. Symp. nutr. Aspects of preserved Food, Swed. Inst. Fd Preservation Res.*, 1954 [1956], 95—103).—The effect of modern manufacturing methods on the biological value of the protein, gastric digestibility, rate of vitamin destruction and hygienic quality of spray- and roller-dried milk powder is discussed. S. C. JOLLY.

Heat transfer to boiling skim milk. S. J. D. van Stralen (*Netherlands J. agric Sci.*, 1956, **4**, 107—110).—The heat flux to boiling pasteurised skim milk was determined by using a horizontal Pt heating wire which served at the same time as a resistance thermometer. A gradually increasing coagulation layer was precipitated on the wire at a constant heat flux of 10 cal. sec.$^{-1}$ cm.$^{-2}$ under atm. pressure, resulting in a rapid decrease in the coeff. of heat transfer. The heat flux to skim milk under a pressure of 10 cm. Hg exceeded considerably that to water at the same temp. of the wire, and a higher max. of nucleate boiling was found. Solutions containing small amounts of skim milk in water had similar high max.

E. M. J.

Beverage quality of reconstituted non-fat dry milk. G. M. Trout and L. Jokay (*Mich. agric. Exp. Sta., Quart. Bull.*, 1956, **38**, 450—459).—In organoleptic tests, 10 brands of separated milk powder (reconstituted) compared favourably with bottled separated milk. No solubility difficulties were encountered, but most of the reconstituted products deposited some sediment. Reasons for the popularity of non-fatty milk in U.S.A. are pointed out.

P. S. ARUP.

Protein hydrolysis. III. Preparation and analysis of sulphurous acid hydrolysates of casein. T. R. Parsons and B. E. Baker (*J. Sci. Food Agric.*, 1956, **7**, 261—265; cf. J.S.F.A. Abstr., 1955, i, 209).—The preparation of a H_2SO_3–HCl hydrolysate of casein is described. The hydrolysate contains relatively less of the acidic amino-acids, and more of the basic amino-acids than does casein; the nutritional value as judged by rat tests was not significantly different.

E. M. J.

Chemistry of casein. G. T. Pyne (*Dairy Sci. Abstr.*, 1955, **17**, 531—553).—A review of the literature. (130 references.)
A. G. POLLARD.

Nomenclature of the proteins of bovine milk. R. Jenness, B. L. Larson, T. L. McMeekin, A. M. Swanson, C. H. Whitnah and R. McL. Whitney (*J. Dairy Sci.*, 1956, **39**, 536—541).—The currently preferred names of milk proteins are summarised and their relations to the classical fractions are indicated. S. C. JOLLY.

Isolation of bovine liver esterase. Booker T. White (*J. Dairy Sci.*, 1956, **39**, 547—551).—A method is described for the purification of an esterase from bovine liver, and its activity towards low-mol.-wt. substrates is reported. Optimum activity using triacetin as substrate in phosphate buffer occurred at ~pH 8·0. It was without action on tenulin, an acetate ester reported to be responsible for " bitter weed flavour " in milk. S. C. JOLLY.

Effect of lipolytic activity and of mercuric chloride on the Babcock test for fat in composite milk samples. L. J. Manus and H. A. Bendixen (*J. Dairy Sci.*, 1956, **39**, 508—513).—Lipolytic activity is responsible for the reduced amount of fat found by the Babcock method in composite milk samples collected over several days and preserved with $HgCl_2$, as compared with the average amounts in the fresh aliquot samples. $HgCl_2$ apparently increases the lipolytic hydrolysis of butter fat; this activating effect is reduced slightly by 20 p.p.m. of Cu and is prevented completely by heating the fresh milks at 160°F. for 30—60 sec. S. C. JOLLY.

Viscosity and flocculation of heated β-lactoglobulin solutions: effect of calcium concentration and pH. C. A. Zittle and E. S. DellaMonica (*J. Dairy Sci.*, 1956, **39**, 514—521).—The increases in η and pptn. of solutions of β-lactoglobulin on heating with Ca ions are dependent on the pH of the solution; the lower the pH, the lower is the effective Ca concn. for pptn., and small changes in pH (possibly <0·1 unit) may be sufficient to render the system unstable to heat. Behaviour of the protein is also affected by preliminary treatment with formaldehyde and HNO_2, indicating that the α-amino group is involved in the reaction with Ca. The latter appears to function largely by effecting an isoelectric pptn. by neutralising negatively charged groups. The effect of heat on these solutions is discussed in relation to the heat stability of milk. S. C. JOLLY.

Determination of xanthine oxidase in milk with triphenyltetrazolium chloride. C. A. Zittle, E. S. DellaMonica, J. H. Custer and R. K. Rudd (*J. Dairy Sci.*, 1956, **39**, 522—527).—A modified method, in which the enzymic reaction is performed in the absence of O_2, is described for the determination of xanthine oxidase in milk. The enzyme concn. in cream (25% butter fat) and skim milk from raw market milk was 140—210 and 25 units respectively. The enzyme is slightly more resistant to temp. of 55—75° in skim milk than is alkaline phosphatase. S. C. JOLLY.

Fat-globule membrane of milk: alkaline phosphatase and xanthine oxidase in skim milk and cream. C. A. Zittle, E. S. DellaMonica, J. H. Custer and R. K. Rudd (*J. Dairy Sci.*, 1956, **39**, 528—535).—The physical and chemical properties of the fat-globule lipoprotein membrane of milk, prep. from unpasteurised cream by washing and churning, have been correlated with xanthine oxidase and alkaline phosphatase activities. The behaviour of this fraction in the ultracentrifuge, in filterability, chemical composition and enzyme content has been compared with that of a related fraction obtained from skim milk. S. C. JOLLY.

Determination of peroxidase activity in milk. L. W. Aurand, W. M. Roberts and J. T. Cardwell (*J. Dairy Sci.*, 1956, **39**, 568—573).—A rapid, convenient and sensitive method for determining the peroxidase activity of milk is based on the oxidation of *p*-phenylenediamine by lactoperoxidase in the presence of H_2O_2. The results obtained are in good agreement with those by the method of Sumner and Gjessing (*Arch. Biochem.*, 1943, **2**, 291).
S. C. JOLLY.

α-Oxoglutaric acid in milk. S. Patton and F. E. Potter (*J. Dairy Sci.*, 1956, **39**, 611—612).—The presence of α-oxoglutaric acid noted previously in milk has been confirmed by chromatographic isolation as its 2 : 4-dinitrophenylhydrazone. It occurs to the extent of about 15 mg. per l., and may arise during the synthesis of glutamic acid for certain milk proteins, or by filtration from the animal's blood.
S. C. JOLLY.

Rapid methods for the determination of the fat content of milk. S. Bakalor (*Dairy Sci. Abstr.*, 1955, **17**, 886—906, 982—1002).—A review. (About 120 references.) A. G. POLLARD.

Electrochemical measurements on milk with cation- and anion-sensitive membrane electrodes. H. E. Affsprung and C. W. Gehrke (*J. Dairy Sci.*, 1956, **39**, 345—355).—The total cationic and anionic activities of milk, expressed as an " activity of monovalent equiv.," were 0·047 and 0·028 respectively; the monovalent activity of K^+ and Na^+ was 0·035. A " generalised activity coefficient " for milk of 0·72 was found from potential measurements on a ternary solution containing KCl, NaCl and $MgCl_2$. The total cationic and anionic potentials for raw and heated skim milk were not significantly different. Membrane-potential measurements on raw and processed milks may be useful for investigating changes in the activities of milk components. S. C. JOLLY.

Physical properties of milk. II. Effects of age on the viscosity of pasteurised whole milk. C. H. Whitnah, W. D. Rutz and H. C. Fryer (*J. Dairy Sci.*, 1956, **39**, 356—363).—A slightly modified Ostwald viscometer is described with which small changes in η of milk can be detected. Increases in η due to storage at 4° of both homogenised and unhomogenised pasteurised milk measured at 4—44° were approx. a linear function of the log of the age of the sample. A chart is presented for estimating the η of milk (4·0 ± 0·05% of fat and 13·0 ± 0·10% of total solids and pasteurised at 62° for 30 min.) at any age from 0—300 hr. from a known value of η.
S. C. JOLLY.

Rapid determination of the major cations in milk. G. K. Murthy and R. McL. Whitney (*J. Dairy Sci.*, 1956, **39**, 364—373).—The acid-pptn. ion-exchange method suggested by Jenness (*Analyt. Chem.*, 1953, **25**, 966) for eliminating the org. matter, PO_4''' and other ions that interfere with the titrimetric determination with edetic acid (ethylenediaminetetra-acetic acid) of Ca and Mg in milk has been modified (by using Na-free reagents) to allow the Ca, Na and K to be determined rapidly and reasonably accurately by flame photometry. The Ca and Mg together are determined titrimetrically with edetic acid, and the Mg obtained by difference.
S. C. JOLLY.

Radiation preservation of milk and milk products. I. Background and problems. S. A. Goldblith and B. E. Proctor. **II. Off-flavours in milk and cream induced by ionising radiations as judged by organoleptic tests.** G. W. Bierman, B. E. Proctor and S. A. Goldblith. **III. Thiobarbituric acid test as a means of evaluating radiation-induced changes in milk.** J. H. Wertheim and B. E. Proctor (*J. Dairy Sci.*, 1956, **39**, 374—378, 379—390, 391—401).—I. The units and terminology used in radiation studies are defined and the destruction of micro-organisms by radiations is explained. The undesirable side-effects of radiations on food constituents and methods of minimising these effects are discussed.

II. The threshold doses at which off-flavours induced by high-voltage radiations were detectable in cream and various types of whole and skim milk varied from 7000 to 25,000 rep depending on the product; off-flavours increased with increasing dosage and fat and moisture contents of the products, but decreased with increasing total-solid contents. The off-flavours in milk were not significantly reduced by preliminary high-temp. short-time pasteurisation. Homogenisation significantly reduced the deterioration of pasteurised whole milk.

III. When applied to irradiated milk, the optical density at 500 mμ. of the colour developed in the thiobarbituric acid test for oxidised flavour, as described by Dunkley (*ibid.*, 1951, **34**, 1064; *Food Technol.*, 1951, **5**, 342), was a linear function of the radiation dose and is believed to be a measure, not of off-flavour components, but of other radiation-induced chemical changes. Chromatographic separation showed that several groups of pigments are formed in the test: (i) the red pigment absorbing at 535 mμ. was produced by all milk components, and (ii) pigments absorbing at 500 mμ. and a heterogeneous group of yellow pigments were produced by all milk components except purified fats. S. C. JOLLY.

Effect of heat treatment on the lipolytic flora of cream. G. M. El Sadek and T. Richards (*J. Dairy Res.*, 1955, **22**, 295—301).—A 97—100% reduction in the tributyrinolytic flora of cream was effected by either " holder " or high-temp. short-time heat treatment; 55% of these organisms also hydrolysed triolein. Micrococci and Pseudomonads were the predominant lipolytic organisms in raw cream; the former alone predominated in heated cream. Tributyrinolytic organisms increased 8- to 13-fold during 24-hr. storage at 8—11°; heat treatment nullified this increase and the lipolytic flora of heated cream was much the same whether or not the cream was stored before heating. Nile blue used as indicator in the triolein medium strongly inhibited most of the triolein-splitting organisms. S. C. JOLLY.

Steam stripping of taints from liquids. III. Batch stripping with particular reference to equilibrium values from batch data. J. K. Scott (*J. Dairy Res.*, 1955, **22**, 302—310).—Methods are given for calculating the degree of taint removal from systems in which steam is bubbled through the liquid, and systems in which the liquid is boiled. The reverse procedure of obtaining equilibrium-curve data from results of batch experiments is also shown. Examples are given for experimental values for removal of diacetyl and acetoin from solution by boiling. S. C. JOLLY.

Steam distillation of taints from cream. I. Theoretical considerations and properties of the reference substances, diacetyl and acetoin. F. H. McDowall (*J. Dairy Res.*, 1955, **22**, 311—327).—The application of Raoult's law and Henry's law to the removal of taint from cream is discussed; for dil. solutions usually found in cream, Henry's law should apply. The equilibrium relations for diacetyl (**I**) and acetoin (**II**) are examined. The equilibrium coeff. for **I** and **II** in water at various concn. are determined together with the activity coeff. and solubility partition coeff. at 100—180°F. **I** is removed equally easily from butterfat and water, but **II** distills in steam much more readily from butterfat. S. C. Jolly.

Microscopic[al] appearance of fat on the milk surface as affected by mechanical disturbance of the surface. N. King (*J. Dairy Res.*, 1955, **22**, 328—335).—The freshly formed surface of milk or cream obtained by overflowing in a double funnel is nearly free from microscopically visible fat. When the surface is disturbed, fat comes to the surface and appears as globules, clumps, lenses or patches; the more disturbed is the surface and the higher the fat percentage of the cream, the more fat there appears. Ageing of milk or cream promotes the transfer of fat to the surface. Fat globules rendered hydrophobic by mechanical treatment of the milk surface, as well as fat patches on the surface, are likely to be available to the action of lipase, and this may explain the agitation activation of lipolysis in raw milk during certain stages in machine milking and transportation. S. C. Jolly.

Comparison of the Gerber and Röse-Gottlieb methods for the determination of fat in milk. W. P. Crocker, D. I. Jenkins, A. L. Provan, F. J. Macdonald, S. J. Rowland and J. C. D. White (*J. Dairy Res.*, 1955, **22**, 336—339).—The findings of the B.S.I. committee responsible for revision of B.S. 696 : 1936 (Gerber method specification) are reported briefly. The % of fat in milk as determined by Gerber method is slightly higher (0·01—0·12% depending on fat %) than is that determined by the Röse-Gottlieb method (B.S. 1741 : 1951), but negligible differences in the results by the two methods would arise if the volume of milk used in the Gerber test were reduced from 11·04 to 10·94 ml. S. C. Jolly.

Lactose-chloride contribution to the freezing-point depression of milk. E. R. Cole and M. Read (*J. Dairy Res.*, 1955, **22**, 340—344).—The direct determination of the partial f.p. depression due to lactose and Cl′ is made by a method involving successive additions of these substances to watered milk. The f.p. depression due to 5% of lactose hydrate is 0·294° and that due to 0·1% of Cl′ is 0·110°. S. C. Jolly.

Volatile compounds associated with oxidised flavour in skim milk. D. A. Forss, E. G. Pont and W. Stark (*J. Dairy Res.*, 1955, **22**, 345—348).—C_6–C_{11} 2 : 4-dienals have been identified in distillates, previously reported to contain C_4–C_{12}-2-enals (*ibid.*, 91), from skim milk with oxidised flavour. The predominating compounds were oct- and non-2-enal and hepta- and nona-2 : 4-dienal, which when added to skim milk in concn. of 10^{-7}—10^{-9}, produced flavour closely resembling oxidised (cardboard) flavour. These compounds which are probably mainly responsible for this flavour defect, probably originate from oxidation of the more highly unsaturated fatty acids in milk lipins. S. C. Jolly.

Structure of milk crumb. J. Saunders (*J. Sci. Food Agric.*, 1956, **7**, 349—354).—The structure of milk crumb is basically an intimate mixture of chocolate liquor, milk solids, sucrose and adsorbed water. The original ingredients remain unaltered during processing, except for a complex formed between sucrose and non-fat milk solids, which has no effect on flavour or flow properties. E. M. J.

Spore-forming organisms in commercial sterilised milk. E. Grinstead and L. F. L. Clegg (*J. Dairy Res.*, 1955, **22**, 178—190).—The cultural and biochemical characteristics are reported of heat-resistant thermophilic and mesophilic spore-forming bacteria isolated from raw and sterilised milk. Modifications are suggested to the tests used to classify this group of bacteria, and a simplified method of distinguishing spore-forming organisms in milk is suggested. Only a limited no. of types of bacteria survive most sterilisation treatments. Thermophiles are restricted to *Bacillus calidolactis* and of the mesophiles, *B. subtilis* predominates in sterilised milk and *B. licheniformis* in raw milk. S. C. Jolly.

Phosphatase test for pasteurisation of milk using disodium phenolphthalein phosphate as substrate. W. J. Tulloch (*J. Dairy Res.*, 1955, **22**, 191—199).—A simple reliable and quantitative method is described of performing the Stiven phosphatase test using disodium phenolphthalein phosphate as substrate; either a long (22 hr.) or short (2 hr.) incubation period is used. The long Stiven test is possibly too stringent compared with the short test, Kay and Graham's test and Aschaffenburg and Mullen's test, the results of all of which show little difference when used for the routine examination of pasteurised milk. S. C. Jolly.

Colour changes in heated and unheated milk. IV. Theoretical background to reflectance changes in separated milk. H. Burton (*J. Dairy Res.*, 1955, **22**, 200—204).—Reflectance changes in milk involving an increase or decrease of reflectance throughout the visible spectrum may be caused by changes in the mean size of colloidal particles, which may be the casein micelles or the sol. protein. Changes in reflectance associated with the browning of milk which vary with λ probably arise from chemical changes in milk involving the production of absorbing molecules. S. C. Jolly.

Nutritional requirements of lactic streptococci isolated from starter cultures. III. Variation in growth-promoting properties of fresh whole milks. A. W. Anderson, R. B. Parker and P. R. Elliker (*J. Dairy Sci.*, 1955, **38**, 1083—1088).—Individual samples of milk varied in peptide (all protein fragments between NH_2-acids and complete proteins) content (*P*). The rate of acid production by mixed-strain commercial starters and by individual strains of lactic streptococci generally increased with increase in *P*. Growth rates of lactic streptococci were apparently affected more by *P* than by protein content, but correlation was poor in milk from mastitic animals and from those in early or late stages of lactation; there were no significant differences between skim milk from Jersey and that from Holstein cows. S. C. Jolly.

Chemistry of formation of butan-2-ol-3-one and diacetyl in cultures of lactic acid bacteria. M. V. Fedorov and L. A. Kruglova (*Dokl. Akad. Nauk SSSR*, 1955, **103**, 161—164).—Addition of 0·6—0·8% of Na citrate, but not of lactose, to peptone broth cultures of *Str. diacetilacticus* leads to production of butan-2-ol-3-one and diacetyl, probably by the reactions: citrate $\rightarrow$ AcOH + Ac·CO_2H + CO_2; Ac·CO_2H $\rightarrow$ CH_3·CHO + CO_2; 2CH_3·CHO $\rightarrow$ Ac_2; 2CH_3·CHO $\rightarrow$ HO·CHMeAc. The aroma of dairy products undergoing lactic acid fermentation can be improved by adding citric acid. R. Truscoe.

Phosphatase activity of chocolate milk. F. V. Kosikowski, A. G. Wolin and W. F. Witter (*J. Dairy Sci.*, 1955, **38**, 1096—1101).—Min. times and temp. for the pasteurisation of chocolate milk (whole milk blended with prepared syrups or powders) are 170°F. for 15·5 sec. or 150°F. for 30 min. Sucrose from the flavouring agent contributes to protection of phosphatase. The importance of proper controls and the effect of sugar on colour development in the phosphatase test are discussed briefly. S. C. Jolly.

Isolation and characterisation of some oxidation products associated with oxidised flavour [in dairy products]. R. R. Riel and H. H. Sommer (*J. Dairy Sci.*, 1955, **38**, 1215—1224).—Limited oxidation of milk phospholipins yielded material that reproduced the typical oxidised flavour in milk. Carbonyl compounds were mainly responsible for the flavour, and five such compounds were separated by chromatography of their 2 : 4-dinitrophenylhydrazones. Empirical formulæ calc. for three of the compounds were $C_{15}H_{26}O_3$, $C_{11}H_{22}O$ and either $C_{22}H_{38}O_2N_5$ (if bis-hydrazone) or $C_{10}H_{18}ON_2$ (if monohydrazone). The C_{15} compound appeared to be a non-conjugated di-unsaturated ketone, and the C_{11} compound was presumably undecanal. S. C. Jolly.

Changes occurring during heat treatment of skim milk at temperatures ranging from 170° to 300°F. H. A. Harland, S. T. Coulter, V. H. Townley and R. Jenness (*J. Dairy Sci.*, 1955, **38**, 1199—1207).—The relation between temp. and time at any given level of serum-protein denaturation changes from a straight-line semi-log. relation, with a "Z" value of 13·5, for temp. of 145° to 175°F. to a curvilinear relation, with a "Z" value of ~19, for temp. of 175° to 195°F.; the "Z" value is still higher at higher temp. Approx. 75% denaturation occurred in 1·7 min. at 200°F. Heat treatments necessary for the production of near-max. amounts of free SH groups in skim milk are defined. The time required at any given temp. to cause measurable sugar–protein interaction gives approx. max. SH activity; further heating produces relatively large amounts of sugar–protein interaction but little increase in SH activity. The loaf-volume depressant factor in skim milk can be inactivated sufficiently by high-temp. short-time heating to secure max. loaf volume; the holding time required decreased with increasing temp. This inactivation is not proportional to total serum denaturation, but 80—85% denaturation should ensure adequate baking quality. S. C. Jolly.

Fluorescence microscopy of fat in milk and milk powder. N. King (*J. Dairy Res.*, 1955, **22**, 205—210).—Fat globules in milk and cream are rendered fluorescent under the blue-light fluorescence microscope by mixing with an aq. solution of the dye Phosphine. The high contrast enables even very small fat globules (in homogenised milk, cream, skim milk or buttermilk) and very thin fat layers on the milk–air boundary or on glass to be distinguished. Fat and proteinaceous material in milk powder can be sharply

differentiated by mixing with glycerol containing two fluorochromes, Phosphine for the fat and basic fuchsin for the protein; differences in the state of fat dispersion caused by manufacturing technique and storage conditions are clearly visible. S. C. JOLLY.

Interrelations of micro-organisms in cream. I. *Streptococcus lactis*, *Pseudomonas fragi* and *Geotrichum candidum*. L. G. Harmon and F. E. Nelson (*J. Dairy Sci.*, 1955, **38**, 1189—1198).—Optimum temp. for growth of *Geotrichum candidum* (*G*) and *Pseudomonas fragi* (*P*) inoculated separately into sterile cream were 30° and 20° respectively; for max. water-insoluble-acid (*A*) production the optimum temp. was 30° for both *G* and *P*. With *P* the more rapid organoleptic deterioration at 30° showed that deterioration was due more to enzyme activity than to bacterial growth. Rancid flavours occurred at lower *A* levels when *Streptococcus lactis* (*S*) was combined with either *G* or *P*. In sterile cream inoculated with *S*, *A* contents frequently decreased. Lipase activity and *A* production of *G* and *P*, and protease activity of *P* were reduced by the presence of *S* and the accompanying lowering of pH. The growth of *P* was inhibited by *S* but that of *G* was stimulated. S. C. JOLLY.

Bacteriology of cultured buttermilk. III. Effect of additions of citric acid, sodium citrate and lactic acid on progressive changes in numbers of *Leuconostoc citrovorum* and *Streptococcus cremoris* as associated with acetylmethylcarbinol plus biacetyl and pH levels. W. E. Glenn and C. C. Prouty (*Appl. Microbiol.*, 1955, **3**, 317—320).—The two organisms were grown in fat-free milk to which the supplements were added. Citric and lactic acids increased the ratio of *L. citrovorum* to *S. cremoris*; Na acetate had the reverse effect. Production of acetylmethylcarbinol + diacetyl was greatest in cultures containing citric acid, lactic acid having a similar though smaller effect. A. G. POLLARD.

Suitability of various methods of detecting watering of buttermilk. F. Kiermeier and G. Pirner (*Z. LebensmittUntersuch.*, 1956, **103**, 437—441).—Various methods for detecting the addition of water to buttermilk, including those of Roeder and of Schulz and Digeser for determining ash content, f.p., refraction and density are critically examined, with regard to accuracy, speed, least apparatus required and quantity of sample. E. M. J.

Effect of salt and of antioxidants on the keeping quality of butter. A. K. R. McDowell (*J. Dairy Res.*, 1955, **22**, 349—364).—During storage at 14°F. butterfat oxidation in sweet-cream New Zealand butter was less in unsalted and highly salted butter than in butter of normal salt content. Antioxidants (fat- and water-sol. substances, surface-active agents and Cu-complexing compounds) retarded oxidation in salted butter, but did not prevent development of "storage" flavour during 8-months' storage. Many of the antioxidants were effective in preventing further fat oxidation and further increase in the intensity of storage flavour during subsequent storage at 60—65°F. S. C. JOLLY.

Cheesemaking without starter. L. A. Mabbitt, H. R. Chapman and N. J. Berridge (*J. Dairy Res.*, 1955, **22**, 365—373).—By using gluconic acid lactone, which hydrolyses slowly to produce a continuous slowly-developing acidity within the curd during setting and after milling, Cheddar and Cheshire-type cheese was produced from raw and pasteurised milk without using starter. The flavour of the best products, while acceptable to some people, was different from that of normal Cheddar cheese. The flavour was not improved by inoculating the cheese milk with a strain of *Lactobacillus casei* or *L. brevis*. S. C. JOLLY.

Development of serologically identified lactobacilli added to cheese made without starter. M. E. Sharpe (*J. Dairy Res.*, 1955, **22**, 374—376).—A method is described for following by serological techniques the development of micro-organisms in cheese made without starter; by using pasteurised milk, sterile apparatus and starters of known serological types, the method might be applicable to the study of flora in ordinary cheese. Neither *Lactobacillus casei* N.I.R.D. H831 nor *L. brevis* N.C.T.C. 6107 gave rise to typical Cheddar flavour when used to inoculate cheese made without a starter. S. C. JOLLY.

Importance of lactobacilli in the production of flavour in Cheddar cheese. I. Growth of lactobacilli in cheese serum. L. A. Mabbitt and M. Zielinska (*J. Dairy Res.*, 1955 **22**, 377—383).—Serum expressed from Cheddar cheese becomes inhibitory to the growth of lactobacilli as the cheese ripens, partly because of the increasing osmotic pressure of the serum due to increasing concn. of amino-acids. Other factors, such as amino-acid imbalance, may be important in the inhibition also. S. C. JOLLY.

Preparation of cheese with crystalline rennin. N. J. Berridge (*J. Dairy Res.*, 1955, **22**, 384—385).—The behaviour during manufacture of cheese made with cryst. rennin instead of with commercial rennet and its unpleasant instead of typical flavour after ripening supports the suggestion of Kizer *et al.* (*J. Dairy Sci.*, 1955, **38**, 303) that impurities in the rennet stimulate either desirable fermentations by the flora or the growth of desirable strains. S. C. JOLLY.

Influence of milk-coagulating enzymes upon some of the constituents and flavour of Cheddar cheese during ripening. H. M. Windlan (*Dissert. Abstr.*, 1956, **16**, 312—313).—Five series of Cheddar cheese were made from raw and pasteurised milk by a technique standardised except for enzyme coagulant. Within each series, two levels of rennet and two levels of rennin-like mould enzyme, proteolytic enzyme X108, and in one series, two levels of papain were used to coagulate the milk. Each cheese was analysed for fat, moisture, salt, and total protein content initially and after periods up to 180 days of ripening at 50° and 60°F., for tyrosine, tyramine and free amino-acid content, total volatile acidity, and free short-chain fatty acids. The pH and flavour development were determined. The results are given and discussed. The total volatile acidity was affected by heat treatment of the milk and the ripening temp. (higher at 60°F. than at 50°F.). Some cheeses developed a bitter flavour. The flavour of the cheese made with the proteolytic enzyme was comparable with that of cheese made with rennet. O. M. WHITTON

Biochemistry of cheese ripening. XVII. The occurrence of free amino-acids and various transaminases in ripening sour milk cheese. J. Schormüller and W. Gellrich (*Z. LebensmittUntersuch.*, 1956, **103**, 291—305).—Fractional pptn. with $(NH_4)_2SO_4$ of glutamic acid-asparaginic acid-aminopherase out of cheese suspension gives a transaminase concentrate that by freeze-drying yields a stable dry prep. By means of a round-filter-chromatogram the amino-acids in the ultra-filtrate of a suspension of thoroughly ripened sour milk cheese were determined. Valine, γ-aminobutyric acid, alanine, glutamic acid and lysine were abundant, phenylalanine, methionine, tryptophan, α-aminobutyric, tyrosine, threonine and serine were found in small quantity. (53 references.) E. M. J.

Influence of microbiological populations on shelf-life of creamed cottage cheese. L. G. Harmon and C. K. Smith (*Mich. agric. Exp. Sta., Quart. Bull.*, 1956, **38**, 368—384).—Retail samples of the cheese show much higher and more variable counts of various types than do samples of the same age that have been obtained fresh from the makers and kept at 5·5°. Samples showing a final pH of <5 keep longer than those showing pH >5, and contain fewer proteolytic and lipolytic organisms, but more yeasts and moulds. No significant correlations are found between keeping quality and free tryptophan contents or organoleptic quality. P. S. ARUP.

Effect in surface ripened cheese of irradiation on spores and toxin of *Clostridium botulinum* Types A and B. R. O. Wagenaar and G. M. Dack (*Food Res.*, 1956, **21**, 226—234).—Data on eight experiments indicated that spores of culture 62A of *Cl. botulinum*, inoculated into surface ripened cheese, were more resistant to irradiation with ^{60}Co than were the spores of either of the other type A strains tested. In general type A spores were inactivated by 800,000 to 1,100,000 rep; type B spores by 550,000 rep. Toxin-producing ability of spores was unaltered by sublethal dosages. In cheese, where the initial Type A *Cl. botulinum* toxin level was above 1000 m.l.d., reduction of the toxicity to below 20 m.l.d. required at least 7,800,000 rep. The dosage required to reduce the toxicity in toxic broths to below 20 m.l.d. was 4,200,000 rep when the initial level was between 200 and 1000 m.l.d. and 5,300,000 rep when the initial level was above 1000 m.l.d. E. M. J.

Variability study in firmness in cheese using the ball-compressor test. C. P. Cox and M. Baron (*J. Dairy Res.*, 1955, **22**, 386—390).—From a variability study of ball-compression readings on the upper faces of 10 Cheddar cheeses it appears that (i) percentage-elasticity readings were generally less discriminating between cheeses than were total-deformation readings, and (ii) based on total deformation, significant differences in firmness may exist across the face of the cheese, the firmness decreasing from the centre outwards. Sufficient accuracy for many routine purposes is given by four total-deformation readings. S. C. JOLLY.

Reviews of the progress of dairy science. Section B. Bacteriology and mycology applied to dairying. E. R. Hiscox and C. A. E. Briggs (*J. Dairy Res.*, 1955, **22**, 391—424).—Recent work on lactic acid and other bacteria and on the bacteriological aspects of starters, cheese, butter, milk control, detergents and disinfectants, and pasteurisation is reviewed. (519 references.) S. C. JOLLY.

Synthetic milk for the study of cheesemaking. I. Preparation of a casein sol in semblance of skim milk. P. E. Grindrod, W. V. Price and H. H. Sommer (*J. Dairy Sci.*, 1956, **39**, 499—507).—A method is described for preparing a casein sol, similar in salt composition to skim milk, without detrimental effect on the casein;

its success depends on a definite order of combining salt components with purified casein at low temp. The sol shows a rate of coagulation and pattern of curd tension development with rennet similar to those of skim milk. The sol should be useful for studying milk-coagulating enzymes, milk fermentations and curd-making processes. S. C. JOLLY.

Paper chromatography and paper electrophoresis as applied to dairy science. E. S. Holdsworth (*Dairy Sci. Abstr., Rev. Art. No.* 46, 1956, **18**, 97—110, 185—198).—The principles of paper chromatography are discussed and its varied applications are reviewed. (Over 150 references.) A. G. POLLARD.

Effect of the egg-shell membrane on bacteria. J. L. Stokes and W. W. Osborne (*Food Res.*, 1956, **21**, 264—269).—There was no evidence in tests with *Pseudomonas aeruginosa, Ps. fluorescens, Salmonella orianienburg* and other bacteria that egg-shell membrane is bactericidal. E. M. J.

Properties of egg-white after storage of eggs in lime water or in cold. V. Orel (*Z. LebensmittUntersuch.*, 1956, **103**, 41—44).—The changes occurring in egg-white during storage of eggs in lime water or in cold (1°) are discussed statistically. The protein indexes between the two groups at 3, 6 and 9 months respectively are 13·0, 12·4 and 11·5%. Data on pH values and whipping capabilities are given. E. M. J.

Development of " freezer burn " on animal tissues. G. Kaess (*Kältetechnik.*, 1956, **8**, 107—108).—A discussion is given of the nature of " freezer burn " on refrigerated meat caused by the sublimation of the ice crystals on the meat surface and the drying out of the meat surface which leads to irreversible degradation of the flesh and development of a yellow to grey colour and so loss in food value. A systematic experimental study of the formation of " freezer burn " is made with samples of ox liver of different sources and ages (and hence fat content) in which the effect and relationships of the following are studied : rate of refrigeration, temp. of chilling, loss of wt. of the meat, and the rate of that wt. loss, the age and fat content of the meat. The results are discussed in full. They explain the findings of refrigeration practice that meat refrigerated under packed conditions that retard evaporation are less likely to develop " freezer burn " than those packed under conditions favouring evaporation. As low evaporation losses can lead to " freezer burn " especial care is necessary in modern practice of quick freezing. (18 references.) H. L. WHITEHEAD.

Hydrolysis of beef proteins by various proteolytic enzymes. D. S. Miyada and A. L. Tappel (*Food Res.*, 1956, **21**, 217—225).—Of the three methods of extraction of sol. meat protein, 0·10N-NaOH gave better results than did either 0·5% KCl or 20% urea. The collagen and elastin determinations were in good agreement with those of hydroxyproline. Bromelin, ficin, trypsin, papain and Rhozym P-11 gave good hydrolysis of sol. beef proteins ; these enzymes may have the necessary proteolytic activity for use in meat tenderisers. (19 references.) E. M. J.

Heat processing of beef. VIII. Sterilising effects of high temperature processes. H. Hurwicz, B. W. Gardner, jun. and R. G. Tischer (*Food Res.*, 1956, **21**, 282—294 ; cf. J.S.F.A. Abstr., 1956, i, 115, ii, 69).—The distributions of F_0 values display a doughnut shaped vol. of lowest values in the central horizontal section of the can. The effect of residual heating (during cooling) on the sterilising effect and its distribution is considerable. The F_0 distributions observed are a secondary effect of distorted temp. distributions (caused by anisotropy of beef and initial temp. gradient in the can) and of residual heating. The F_0 distributions observed emphasise the necessity of basing thermal process determination on the vol. lethality concept. F_0 determination is subject to great experimental variation. The size of the sample should be determined by statistical methods to ensure a safe but not overprocessed product. (12 references.) E. M. J.

Comparison of non-treated and fried fresh and frozen beef as to losses of weight after canning. O. Dahl (*Proc. Symp. nutr. Aspects of preserved Food, Swed. Inst. Fd Preservation Res.*, 1954 [1956], 133—137).—The drained wt. of solid meat in cans of beef is slightly higher if the meat is rapidly machine-fried before canning ; slow pan-frying results in a lower wt. of solid meat than does canning raw beef. The behaviour of fresh and frozen beef was not significantly different. S. C. JOLLY.

Effect of two methods of cooking on palatability scores, shear force values, and collagen contents of two cuts of beef. S. Cover and W. H. Smith, jun. (*Food Res.*, 1956, **21**, 312—321).—Steaks from the *biceps femoris* muscle were more tender when braised than broiled. Highly significant correlations were obtained between tenderness scores and shear force values by both methods of cooking and for cuts from *biceps femoris* and *longissimus dorsi*. Collagen N content was highest in *biceps femoris* and lowest in *psoas major*. Comparisons are made between moist and dry heat methods of cooking and effect on tenderness. (20 references.) E. M. J.

Respiratory enzymes of meat. III. Influence of various ions on beef succinoxidase. N. H. Grant (*Food Res.*, 1956, **21**, 326—328 ; cf. J.S.F.A. Abstr., 1956, i, 43).—The influence of a no. of ions (of inorg. salts used in meat processing) on beef succinoxidase was examined. NaCl, $NaNO_3$, Na_2SO_4, KCl, $CaCl_2$ and $MgSO_4$ are capable of inhibiting beef succinoxidase. E. M. J.

A new muscle protein, metamyosin. L. Raeber, G. Schapira and J.-C. Dreyfus (*C. R. Acad. Sci., Paris*, 1955, **241**, 1000—1003).—A new muscle protein, metamyosin, has been detected in the fœtal muscles of rabbit and sheep, and in smaller amounts in adult muscles, and is characterised by a considerably lower electrophoretic mobility than that of the other muscle proteins. J. S. C.

Meat tenderisation. I. Two mechanical devices for measuring texture. D. S. Miyada and A. L. Tappel (*Food Technol.*, 1956, **10**, 142—145).—Two methods for measuring meat texture based on the use of a motorised Christel Texturemeter and a household food grinder are described. From a comparison of coeff. of variation values, the Christel Texturemeter (1·99%) and the Hamilton-Beach food grinder (2·11%) gave more precise measurements than did the Warner-Bratzler shear device (1·37%) E. M. J.

Paper-chromatographic determination of carnosine. O. Högl (*Mitt. Lebensm. Hyg., Bern*, 1955, **46**, 527—536).—Carnosine (β-alanylhistidine) can be determined chromatographically with the use of 60% 2-methylpyridine as ascending solvent (time 3 hr.), and development by the reagents used for the detection of histidine (diazotisation and coupling with *p*-anisidine). The histidine contents of meat extracts are normally negligible, but should histidine occur in appreciable amounts, it must be separated from the carnosine by a more lengthy chromatographic process. The colorations of the spots are compared with those of spots obtained from known amounts of carnosine, by means of the Sulser photoelectric Leukometer. The average variation between results based on 10 μg. of carnosine is 2·2%, and between determinations on meat extracts, 5—8%. The recovery of carnosine added to meat extracts amounts to 94%. Carnosine contents are tabulated for 13 extracts from beef, mutton, and chicken- and whale-meat. (16 references.) P. S. ARUP.

Qualitative detection of nitrite by means of paper chromatography. K. Täufel and R. Serzisko (*Ernährungsforschung*, 1956, **1**, 149—151).—The detection is based on the use of Bu^nOH–pyridine–1·5N-aq. NH_3 as ascending solvent, in which NO_2' shows an R_F value of 0·25. After air-drying, NO_2' is revealed by the red coloration formed on spraying with an acidified (with H_2SO_4) solution of 1-naphthylamine in acetone. An example is given demonstrating the detection of 5 μg. of NO_2' in a (filtered and clarified) aq. extract of pickled meat. P. S. ARUP.

Modified collodion membranes impermeable by proteins with comparatively small molecules. G. S. Adair (*Biochem. J.*, 1956, **62**, Proc. xxvi.)—A modified collodion membrane is described for work on pressure dialysis and measurements of osmotic pressures of proteins with comparatively small mol. Consistent results are obtained with a protein derived from elastin with mol. wt. as low as 5500 ± 100. The permeability of the ordinary fairly high permeability membrane is decreased by treatment with aq. glycerol. J. N. ASHLEY.

Protein decomposition in semi-preserved herring. F. Alm (*Proc. Symp. nutr. Aspects of preserved Food, Swed. Inst. Fd Preservation Res.*, 1954 [1956], 108—111).—Changes occurring in the wt. and protein of sprats during the ripening process in the preparation of Swedish anchovies by packing the fish (*Clupea sprattus*) into tins, adding salt, sugar and spices, and sealing the tins are reported. S. C. JOLLY.

Rôle of histamine in poisoning with spoiled fish. E. Geiger (*Proc. Symp. nutr. Aspects of preserved Food, Swed. Inst. Fd Preservation Res.*, 1954 [1956], 112—114).—During the bacterial spoilage of round fish, but not of flat fish, large amounts of histamine are produced. Feeding histamine solutions or histamine-containing fish meat does not produce toxic symptoms in normal animals, but does so only after damaging the intestinal mucosa with, for example, saponin solution. Fish poisoning is therefore apparently due to toxins other than histamine produced during spoilage, except perhaps when the fish is highly spiced or alcohol is consumed at the same time, thus facilitating the passage of histamine through the intestinal wall before it can be detoxified. S. C. JOLLY.

Heat and water transfer during the dehydration of herring fillets. M. M. del Campo and C. L. Cutting (*J. Sci. Food Agric.*, 1956, **7**, 417—424).—Results of experiments on the effect of varying temp.,

R.H., air velocity, size and fat content of the fillets, and the arrangement of the fillets on the rate of drying of herring fillets in an " overdraught " truck and tray dryer, indicated that the rate of drying was very sensitive to temp.; unaffected by ranges of wet-bulb depression and air velocity; compared with lean, fatty herrings took longer to dry and fat oxidation occurred. Thickness of the fillet had some effect. Storage life depended (*a*) on the oxidation of the fat (prevented by packing in an inert gas) and (*b*) the growth of moulds if the moisture content was above ~16% (corresponding to ~70—75% R.H.). The max. tolerable storage life of the product in edible condition even at 10% moisture content was ~5 months at 80°F., but the palatability compared not unfavourably with samples of native-cured fish in tropical regions. E. M. J.

Calcium and phosphorus contents of some foreign and domestic canned sardines. A. da Costa and J. A. Stern (*Food Res.*, 1956, **21,** 242—249).—Ca and P in 42 different brands of sardines were determined. Plain sardines had the highest, and the skinless and boneless sardines the lowest Ca and P contents, Ca : P being 1 : 1 in all brands except in the skinless and boneless sardines where the ratio was 1 : 6. (20 references.) E. M. J.

Red halophilic bacteria in solar salt and salted fish. I. Effect of Bacto-oxgall. II. Bacto-oxgall as a selective agent for differentiation. H. P. Dussault (*Fish Res. Bd Canada*, 1956, **13,** 183—194, 195—199).—I. Bacto-oxgall has a differential effect on the red halophilic bacteria commonly found in solar salt and in contaminated salted fish. *Pseudomonas salinaria* was inhibited by low while *Sarcina littoralis* tolerated high concentrations of oxgall. The inhibition of *Ps. salinaria* results from the lysis of the bacterial cells, as indicated by clearing of the suspension and by microcopical examination, the action of the oxgall being effective and rapid, not affected by variations in pH, but the presence of proteins exerts a protective effect against its inhibitory power. Bacto-oxgall has inhibitory power equal to that of Na taurocholate, and, when diluted to the equiv. of fresh bile is three times more effective than fresh cod bile. (23 references.)

II. Eighteen strains of red halophic bacteria isolated from various sources were tested: all the members of the rod group were inhibited by low concentrations of oxgall and all those of the coccus group tolerated relatively high concentrations, this method differentiating one group from the other. The test has been found useful for isolating and purifying unidentified strains and for determining the relative proportions of the two main types of red halophilic bacteria present in discoloured salted codfish and in solar salt samples. E. M. J.

Note on the production of nitrite from hydroxylamine by heterotrophic bacteria. C. H. Castell and E. G. Mapplebeck (*Fish Res. Bd Canada*, 1956, **13,** 201—206).—Cod muscle dipped in a solution of hydroxylamine developed small amounts of nitrite during storage. In tests with peptone–yeast–beef broth containing ~25 p.p.m. of hydroxylamine many cultures of *Pseudomonas* and certain species of *Proteus* and *Microbacterium* were able to convert hydroxylamine to nitrite. E. M. J.

Spoilage of fish in vessels at sea. III. Value of nitrite ice and nitrite dips for the preservation of gutted fish in the hold of the vessel. C. H. Castell and G. K. Gunnarsson (*Fish Res. Bd Canada*, 1956, **13,** 207—218; cf. J.S.F.A. Abstr., 1956, i, 326).—For gutted fish in boats at sea, stored either in pens or boxes, a short dip in 1% Na nitrite solution consistently added at least four days to their keeping time. The dipping was more effective than storing in flake ice made of 0·1% solution of Na nitrite. There was no advantage in using nitrite as a dip or in ice with fish that were properly iced and not stored longer than six days. E. M. J.

Stabilisation of edible fats by spices. II. New antioxidant from betel leaf. S. C. Sethi and J. S. Aggarwal (*J. sci. industr. Res.*, 1956, **15B,** 34—36).—The effect of various spices as antioxidants in the preservation of groundnut oil and lard has been studied. 4-Allylpyrocatechol (hydroxychavicol) has been isolated from betel leaf and is shown to exhibit a strong antioxidant effect. The antioxidant effect of red chillies is due to the synergistic action of ascorbic acid in combination with natural antioxidants in the oil. The antioxidant effect of cloves seems to be due to substances produced on heating the cloves with the oil. *Iso*eugenol is a strong antioxidant and may be produced in this way. (10 references.) C. A. SLATER.

Spectrophotometric determination of vitamin A in Indian marine fish liver oils. S. Balasundaram, H. R. Cama, P. R. Sundaresan and T. N. R. Varna (*J. sci. industr. Res.*, 1956, **15C,** 23—27).—The high- and low-potency Indian marine fish oils have been examined for vitamin A_1, vitamin A_2 and *neo*-vitamin A_1 content. The spectrophotometric method used necessitates a correction for " irrelevant " absorption. The validity of this correction has been confirmed by a chromatographic separation method, examining the fractions for vitamin A_1. (12 references.) C. A. SLATER.

Tocopherol and vitamin-A content of some marine blubber oils. C. A. Heller (*Dissert. Abstr.*, 1956, **16,** 226—227).—Tests showed that blubber oils from the Pacific Harbour seal, the bearded seal, the beluga whale, the baleen whale, and the walrus contain negligible amounts of carotene, fair amounts of vitamin A and from 6·7—38·3 mg. of tocopherol per 100 g. of oil. The bioassay values for vitamin A ranged from 32 to 75% of those obtained chemically. Tocopherol values obtained by the molecular distillation method of Quaife and Harris agreed with those obtained by Krukovsky's modification of the Parker–MacFarlane direct method. The oils furnish from 40 to 50% of the calories of the Alaskan Eskimo diet. Practical suggestions are made for maintaining their vitamin A and tocopherol content during rendering and storage. O. M. WHITTON.

Analytical characterisation of oxidisability of unsaturated fats. K. Täufel and R. Vogel (*Ernährungsforschung*, 1956, **1,** 142—148).—In a modified version of the Swift test, purified air after bubbling through the oil sample (20 ml. heated in boiling water) at a constant rate (5 l. per hr.) is led (for the acid indicator test) through a pH-indicating solution, or (for the peroxide indicator test) through an acidified (with AcOH) KI–starch indicator solution. The no. of min. taken for the indication of pH 4·5 in the former test, or a recognisable blue coloration in the latter test affords a quant. basis for comparing the oxidisabilities of oils or fats. Acid indicator values are always considerably greater than the corresponding peroxide values. The former values are unsuitable for judging oils or fats rich in glycerides of volatile acids (e.g., butterfat or coconut oil), but suitable for judging other more easily oxidised oils. The complete reverse applies to the latter values. Both tests give reproducible values and have proved useful for detecting oxidation effects (sometimes undetectable by the usual peroxide value determination) in oil mills and refineries, for testing the efficiency of antioxidants, and other similar purposes. P. S. ARUP.

Iodimetric determination of peroxide value of edible fats. C. Franzke (*Z. LebensmittUntersuch.*, 1956, **103,** 108—112).—The methods of Täufel and Rothe (cf. *Angew. Chem.*, 1949, **61,** 84) and of Sully (cf. *Anal. Abstr.*, 1954, **1,** 977) are preferred to two other well-known methods, the former on account of its rapidity and convenience, and the latter on account of its superior accuracy. Minor modifications are proposed for the improvement of the accuracy of both the preferred methods. P. S. ARUP.

Determination of 1-monoglyceride. C. M. Dowse and J. A. Saunders (*Biochem. J.*, 1956, **62,** 455—458).—A method is described for determination of 1-monoglycerides, based on determination of the formaldehyde produced during oxidation of the monoglyceride with HIO_4. The method eliminates uncertainties that occur in the titration method of Pohle *et al.* (Brit. Abstr. B, 1950, II, 813) when used with unsaturated fats. The procedure is similar to that of Corcoran and Page (*J. Lab. clin. Med.*, 1948, **33,** 1326), but the acetic acid in the oxidation mixture is replaced by propionic acid, the chloroform is removed by aëration under reduced pressure, and steam is used as well as distillation to remove the formaldehyde which is determined colorimetrically by the chromotrope acid method. J. N. ASHLEY.

Essential fatty acids in human nutrition. L. Söderhjelm (*Proc. Symp. nutr. Aspects of preserved Food, Swed. Inst. Fd Preservation Res.*, 1954 [1956], 138—141).—Evidence in favour of the hypothesis that polyunsaturated fatty acids (linoleic, linolenic and arachidonic acids) are essential in human nutrition is surveyed. S. C. JOLLY.

Nutritional effects of rancid fat. G. Borgström, K. Lang, C. A. Frazer, F. Bramsnaes, H. Cheftel and G. Wode (*Proc. Symp. nutr. Aspects of preserved Food, Swed. Inst. Fd Preservation Res.*, 1954 [1956], 144—150).—A discussion of the health hazards in consuming rancid fats. S. C. JOLLY.

Analysis of fatty vegetable materials by infra-red absorption. A. Berton (*C. R. Acad. Sci., Paris*, 1955, **241,** 1291—1293).—The i.r. photometer previously described (*ibid.*, 1954, **238,** 477; J.S.F.A. Abstr., 1954, ii, 144) was used to obtain i.r. spectra, between 2 and 15 μ., of various vegetable oils, enabling a rapid qual. analysis to be made. Quant. analysis is only possible in certain cases where intense and well differentiated bands can be obtained. Determination of OH-groups is always feasible. J. S. C.

Mycological formation of fat. II. Synthesis of fat from various carbohydrates in surface cultures of *Aspergillus nidulans*, *Penicillium javanicum* and *Penicillium spinulosum* and the influence of the nitrogen source on the synthesis of fat from glucose. J. M. Garrido and T. K. Walker. **III. Media conducive to formation of fat from sucrose by *Penicillium soppii* Zaleski in surface culture.** S. Murray and T. K.

Walker (*J. Sci. Food Agric.*, 1956, **7**, 233—237, 237—240).—II. Excluding sucrose, xylose was the most effective sugar, next to glucose, as a substrate for the production of fat by the above moulds. Nine carbohydrates were tested; data are presented on the four giving the best results, viz., xylose, glucose, maltose and inulin. From xylose, *P. javanicum* produced 4·61 g. of felt containing 1·24 g. of fat in nine days, the fat coeff. (g. fat/g. xylose utilised) being 5·8; *A. nidulans* developed 3·61 g. of felt containing 0·69 g. of fat in the same time, this mould having a fat coeff. of 8·8. NH_4 nitrate was the best source of N for all three moulds, but for *A. nidulans*, Na nitrate, or urea could also be used.

III. Data are presented on the effect of certain inorg. salts and of maize steep liquor on fat production in cultures of *P. soppii*. Addition of maize steep liquor enhanced the production of fat by the mould. Felts containing >40% of fat were obtained with yield of fat of 12·5% on sucrose metabolised. E. M. J.

Alkaline hydrolysis of lecithin. I. Properties of cyclic 1 : 2-glycerophosphate. II. Reactions of the double bond of sphingosine. N. A. Bates (*Dissert. Abstr.*, 1956, **16**, 226).—On mild alkaline hydrolysis, lecithin (**I**) produced glycerophosphate and methyl glycerophosphate which accounted for all the P present. Cyclic 1 : 2-glycerophosphate (**II**) was prepared by the method of Ukita and characterised. Attempts to detect **II** as an intermediate in hydrolysis of **I** are described.

II. Pure sphingosine (**III**) (10—12%) was obtained by hydrolysing cerebroside with MeOH–H_2SO_4. Hydrolyses with IR-120 (H), aq. H_2SO_4 and Sn, and $Ba(OH)_2$ followed by EtOH–HCl were also investigated, The separation of **III** and related compounds by paper chromatography was studied. Pure triacetylsphingosine epoxide (11%, m.p. 137—138°, α_D 15·1°) was prepared by reaction of triacetylsphingosine and perphthalic acid at room temp. A crude sphingosine sulphate prep. reacted rapidly with perphthalic acid at 4°. The reaction mixture was reduced with $LiAlH_4$ to give the *N*-benzoyl derivative and two cryst. fractions, neither of which corresponded to *N*-benzoylphytosphingosine.

O. M. Whitton.

Synthesis of glycerolphosphatides. E. Baer (*Canad. J. Biochem.*, 1956, **34**, 288—303).—Synthesis and structural nature of phospholipins and lecithins are reviewed. It is found that the natural glycerol phosphatides, and their P-containing intermediates, are all derivatives of L-α-glycerophosphoric acid. J. S. C.

Chemistry of phosphoinositides. J. Folch and F. N. LeBaron (*Canad. J. Biochem.*, 1956, **34**, 305—318).—The phosphoinositides, first discovered in the lipids of the tubercle bacillus and since found in many animal and vegetable tissues, with one possible exception, contain 1 mol. of glycerol per mol. of inositol, the latter being normaly present as a monoester of H_3PO_4. The information available about the structure of these substances is reviewed: in no case has identification been completed. (30 references.) J. S. C.

Crystallisation of cocoa butter and alternative fats. II. Palm kernel stearins and their mixtures with cocoa butter and butter fat. E. H. Steiner (*J. Sci. Food Agric.*, 1956, **7**, 425—436; cf. J.S.F.A. Abstr., 1956, i, 171).—The results are presented of calorimetric and cooling curve measurements on eight palm kernel stearins with a view to assessing their suitability for use in chocolate products. Consideration is given to phase composition and crystallisation of the stearins alone and in admixture with cocoa butter and butter fat in binary and ternary mixtures. E. M. J.

Stabilisation of fatty foods by use of antioxidants and synergistic agents. K. Täufel (*Ernährungsforschung*, 1956, **1**, 85—89).—A review. P. S. Arup.

Nutrition and food technology. G. Borgström (*Proc. Symp. nutr. Aspects of preserved Food, Swed. Inst. Fd Preservation Res.*, 1954 [1956], 11—23).—Recent developments in food processing are reviewed briefly, with particular reference to the retention of nutritional constituents, changes in composition during processing and storage, and the use of additives (preservatives, vitamins, antibiotics, antioxidants, etc.). S. C. Jolly.

Recent progress in the field of nutrition. R. A. Gortner, jun. (*Proc. Symp. nutr. Aspects of preserved Food, Swed. Inst. Fd. Preservation Res.*, 1954 [1956], 24—32).—The importance of adequate and balanced diets in relation to protein malnutrition, drug addiction, obesity, dental caries and antibiotic feeding, and new knowledge of the interrelation of specific enzymes, vitamins and minerals in the metabolism of foodstuffs are reviewed briefly. S. C. Jolly.

Significance of peptides in protein nutrition. O. Mellander (*Proc. Symp. nutr. Aspects of preserved Food, Swed. Inst. Fd Preservation Res.*, 1954 [1956], 61—65).—In assessing the nutritional value of vegetable proteins, the formation of large peptides during *in-vivo* digestion is important in addition to the amino-acid composition of the protein; the larger the mol. size of the peptides the better apparently is the protein. Such peptides are formed during the digestion of certain milk proteins. Large peptides may be important nutritionally as solubilising agents for certain other important factors. S. C. Jolly.

Amino-acid composition of plant protein. G. Ågren (*Proc. Symp. nutr. Aspects of preserved Food, Swed. Inst. Fd Preservation Res.*, 1954 [1956], 66—74).—The amino-acid composition of some Swedish plant foods and waste products of plant origin [sweet blue and sweet yellow lupins (*Lupinus luteus*), field bean, potato (*Magnum bonum*), golden rain oats, Maja barley, molasses, linseed, groundnut, rape, meadow fescue, red clover, and brewer's, sulphite and autolysed baker's yeasts] have been determined and the results used for biological evaluation of the plant protein. The free amino-acids in human foetal and adult liver and muscle are also reported. S. C. Jolly.

Determination of lanthionine in amino-acid mixtures: the separation of its diastereoisomers on columns of ion exchange resins. S. Blackburn and G. R. Lee (*Analyst*, 1955, **80**, 875—879).—A method for the direct determination of lanthionine on protein hydrolysates or mixtures of amino-acids is described. Chromatographic separation is effected on columns of the Na form of Dowex 50 by the method of Moore *et al.* (Brit. Abstr. C., 1952, 62), a buffer solution of pH 3·42 but without dithioglycol being used for development. Fractions (1 ml.) of the eluate are examined with a ninhydrin reagent (prep. described) at pH 1. The optical density of each fraction is measured at 455 mμ. and the total lanthionine present is ascertained from a calibration graph. The emergence of lanthionine is indicated by a yellow peak followed after an interval by a red peak due to proline. Separation of the individual diastereoisomers of lanthionine on these columns and their i.r. spectra are described. A. O. Jones.

Use of phosphorescence at ordinary temperature as a method of chemical analysis: first application to amino-acids. B. Rybak, R. Lochet and A. Rousset (*C. R. Acad. Sci., Paris*, 1955, **241**, 1278—1280).—The phosphorescence of solid samples of amino-acids, illuminated by u.v. radiation, is a means of identification. "Spectrograms" of L-alanine, DL-phenylalanine, L-tryptophan and glycine are reproduced to demonstrate this fact and their significance is discussed. J. S. C.

α-Carotene in leaves of the carrot plant. V. H. Booth (*J. Sci. Food Agric.*, 1956, **7**, 386—389).—The average content of total carotene in the leaves of 30 (10 high carotene + 20 ordinary) batches was 117 p.p.m.; α-carotene comprised on average 13% of the total carotene. No α-carotene was found in the leaves of fodder types or of wild carrots, or in those of the colourless-rooted freak, although the content of β-carotene was normal. α-Carotene was present in the cotyledons of very young ordinary seedling carrots comprising 19% of the total carotene. (12 references.) E. M. J.

Vitamin A content of fish viscera, and considerations concerning vitamin A supplies. A. Scheunert, R. Cordua and L.-L. Stammer (*Ernährungsforschung*, 1956, **1**, 71—78).—Numerous data are given for the vitamin A contents of the various parts of the visceral organs and of other parts of sea-fish. A few similar data are given with respect to river-fish. Prospects for the development of these sources are considered favourable. P. S. Arup.

Colorimetric behaviour of vitamin A with dilute solutions of antimony trichloride. New reaction for vitamin A. G. Cavina (*Ann. Chim., Roma*, 1956, **46**, 43—61).—The colorimetric behaviour of vitamin A treated with solutions of antimony trichloride (0·4—10%) in chloroform is reported. After an initial blue coloration, in 2 min. a red-violet colour ($\lambda_{max.}$ 550 mμ.) appears, which is shown to be due exclusively to $SbCl_3$ and not to $SbCl_5$. This also occurs with β-carotene and vitamin D_2. Other solvents are also tested with some success. On the basis of this reaction a simple and accurate method of analysis for vitamin A is described. Appropriate absorption curves are illustrated for vitamin A, vitamin D_2 and β-carotene. 22 references.) C. A. Finch.

Question as to alterations in vitamin A and C contents of highly nutritive beverages kept in [aluminium] "Alu" bottles (whey bottles) during long sporting tours. H.-K. Gräfe (*Ernährungsforschung*, 1956, **1**, 133—141).—Gruel containing egg-yolk, "dextropur", and NaCl lost no vitamin A or carotene when kept during 8 hr. in the Al bottles. A strong tea-infusion containing lemon-juice and honey lost, during 8 hr., 11—24% of its original content of vitamin C. The tea beverage dissolved traces of Fe and Al from used bottles, but not in amounts sufficient to affect the taste. When kept in new bottles, the tea acquired a metallic taste. The addition of synthetic ascorbic acid to the tea (100 mg. per 0·7—1 bottle) is recommended. P. S. Arup.

Available nutritional sources of vitamin C, and preparation of vitamin C concentrates from plant raw materials. A. Scheunert (*Ernährungsforschung*, 1956, **1**, 58—70).—A review covering numerous data for vitamin C contents of common vegetables and fruits (fresh, frozen and tinned) and of other plant materials, and proposals for increasing the availability of the vitamin, especially during winter and spring (when the vitamin content of potatoes is at its lowest). (14 references.) P. S. ARUP.

Bound form of ascorbic acid. IX. Fluorometric determination of ascorbigen. V. Šícho and E. Bradáčová (*Česk. Farm.*, 1955, **4**, 451—454).—The method is based on the production of a compound of unknown composition by the reaction of ascorbigen with formaldehyde in acid medium. The product has a yellow fluorescence in u.v. light, the intensity of which is related linearly to the concn. of ascorbigen between 0·15 and 1 μg. per ml. of solution. The intensity is dependent on pH, decreasing markedly at pH >3. The method is suitable for determination of ascorbigen in plant juices. As some indole derivatives such as β-indolyl-acetic, -propionic and -butyric acids, tryptophan, tryptamine and gramine interfere, they are separated, when present, by paper chromatography.
A. O. JAKUBOVIC.

Ascorbic acid in vegetables and fruits. Physiological importance. Human requirements, and rôle of fruits and vegetables in their satisfaction. F. Giroud (*Ann. Nutr., Paris*, 1955, **9**, A337—A359).—A review with 109 references. P. S. ARUP.

The rôle of ascorbic acid and dehydroascorbic acid in plant and animal metabolism. I. H. von Euler and H. Hasselquist (*Hoppe-Seyl Z.*, 1956, **303**, 176—183).—The decrease in viscosity of pectin solutions in the presence of ascorbic acid and H_2O_2 and the formation of the oxidation products, acetaldehyde and acetic acid, have been quantitatively demonstrated in systems containing ascorbic acid, H_2O_2, ethanol and $FeCl_3$ at differing H_2O_2 concn. Ascorbic acid acts catalytically in the oxidation. In a similar system using dehydroascorbic acid, 1 millimol. of dehydroascorbic acid with 4 millimol. of of H_2O_2 produces 0·9 millimol. of acetaldehyde and 0·042 millimol. of acetic acid, giving a total equivalent of 0·51 millimol. of oxidised ethanol. With mesoxaldehyde (derived by oxidation from triose reductone), 0·29 millimol. of acetaldehyde are produced, which is equivalent to 4 millimol. of ethanol. G. R. WHALLEY.

Vitamin interrelationships of ascorbic acid. T. Terroine (*Ann. Nutr., Paris*, 1955, **9**, A361—A405).—A review covering available evidence for the capacity of ascorbic acid to compensate for deficiencies in vitamins A, E, B_1, B_2, B_{12}, biotin and pantothenic and folic acids, a discussion of probable compensating mechanisms, and the antiscorbutic effects of other vitamins in the absence of ascorbic acid. (71 references.) P. S. ARUP.

Rôle of fruits and vegetables in wholesome human dietary in France. Therapeutic uses. J. Trémolières and J. Claudian (*Ann. Nutr., Paris*, 1955, **9**, A407—A462).—A review of data covering seasonal, economic, industrial, regional, sociological, psychological and physiological aspects. P. S. ARUP.

The chromatographic separation of the phosphoric esters of thiamine and its applications. G. de la Fuente, R. Díaz Cadavieco and A. Santos Ruiz (*Rev. esp. Fisiol.*, 1955, **11**, 197—208).—The direct phosphorylation of thiamine with H_3PO_4 resulted in all cases in the formation of mixtures of mono-, di-, tri- and sometimes tetra-phosphoric esters, which were separated by chromatography. Neither the monophosphoric nor the triphosphoric ester has cocarboxylase activity and neither ester in the concentrations tried was inhibitory. (16 references.) E. M. J.

Study of progress of hydrolytic degradation of inositol hexaphosphate by paper chromatography. A. Desjobert and F. Petek (*C. R. Acad. Sci., Paris*, 1955, **241**, 1343—1345).—The chromatographic separation of the hydrolytic (chemical or enzymic) products of inositol hexaphosphate was effected by descending chromatography using a solvent composed of propanol (5 vol.), aq. NH_3 (4 vol.) and distilled water (1 vol.), and an alcoholic $FeCl_3$ solution, followed by an alcoholic solution of sulphosalicylic acid, as spray developers. Results are shown for the two types of hydrolysis mentioned after various periods of time. J. S. C.

Use of vitamin B_{12} in food products. N. Nielsen (*Proc. Symp. nutr. Aspects of preserved Food, Swed. Inst. Fd Preservation Res.*, 1954 [1956], 126—131).—The importance of vitamin B_{12} in the growth of man and animals is surveyed. The use of vitamin B_{12} makes possible an increased production of animal protein in that inferior feed can be used, and also it can improve a diet inferior for human beings. S. C. JOLLY.

Control of the use of chemical aids in food processing. A. C. Frazer (*Proc. Symp. nutr. Aspects of preserved Foods, Swed. Inst. Fd Preservation Res.*, 1954 [1956], 159—169).—The use of chemical and physical, technological, biochemical, pharmacological and nutritional data in assessing the health hazards of chemical additives in food is discussed. S. C. JOLLY.

Use of chemical additives in food processing. Food Protection Commee, Food & Nutrition Branch, Nat. Res. Coun. (U.S.A.) (*Nat. Acad. Sci., Wash.*, 1956, Publ. 398, 86 pp.).—A discussion is given of the technological advantages of the use of artificial and natural "intentional" additives in various foods, i.e., substances added for colouring, flavouring, sweetening, fortification, preservation, emulsification or bleaching purposes. A list is provided of a large range of such substances and the levels of use in various foods. H. S. R.

Detection and identification of fat-soluble tar colouring matter in foods by extraction with acid mixtures and chromatography on impregnated paper. W. Lindberg (*Z. LebensmittUntersuch.*, 1956, **103**, 1—4).—A method, suitable for control tests in foods, is described for the detection and identification of tar-colouring matters sol. in oil. The colouring matter in oil solution is dissolved in light petroleum, treated with acid solution and extracted with ether. The residue after driving off the ether is saponified, the unsaponifiable matter is isolated and dissolved in ethyl acetate. The identification follows on chromatographic paper which has been impregnated with liquid paraffin, the mobile solvent being methanol 80% by vol. and 5% of acetic acid. Nine colouring matters were tested in this way. E. M. J.

Risks of carcinogenic action from substances added to foods to improve the organoleptic qualities. R. Truhaut (*Ann. Falsif., Paris*, 1956, **49**, 107—127).—The various substances intentionally added to foods (*a*) to preserve (antiseptics, antioxidants, etc.), (*b*) to improve savour and odour (condiments, synthetic aromatic compounds, etc.), and (*c*) to improve the appearance and consistence (thickening agents, improvers of flour, colouring matter, etc.) are reviewed. The formula of a dye gives no indication that it is non-carcinogenic. E. M. J.

Prevention of adulteration in provision trade. F. F. Achermann (*Mitt. Lebensm. Hyg., Bern*, 1955, **46**, 475—482).—Comments are made on Swiss legislation from the point of view of the analyst. P. S. ARUP.

Chemical impurities in foods. J. Deshusses (*Mitt. Lebensm. Hyg., Bern*, 1955, **46**, 464—474).—A review covering cases of poisoning due to unforeseen or accidental causes, contamination during manufacture, and toxic insecticide residues in plant products. (51 references.) P. S. ARUP.

Rôle of preserved foods in the dietary regimes of military establishments. K. A. Delphin (*Proc. Symp. nutr. Aspects of preserved Food, Swed. Inst. Fd Preservation Res.*, 1954 [1956], 171—173).—A brief outline is given of the canned, vacuum-dried and frozen foods used in the Swedish army. S. C. JOLLY.

Effects of feeding polyoxyethylene preparations to rats and hamsters. C. E. Poling, E. Eagle and E. E. Rice (*Food Res.*, 1956, **21**, 337—346).—Animals fed polyoxyethylene-derived surface active prep. (two polyoxyethylene stearates and polyoxyethylene sorbitan monolaurate) were: retarded in growth, of small adult size, had decreased efficiency of food utilisation, increased water consumption (in rats), unthrifty appearance, increased mortality, consistent diarrhœa, and hæmorrhage from genito-urinary tract (in hamsters). Harmful effects in animals even in a dietary level of 5% indicate the caution necessary before such substances are used in foods for human consumption. (29 references.) E. M. J.

Fate of ingested polyoxyethylene (20) sorbitan monostearate in rats. A. N. Wick and L. Joseph (*Food Res.*, 1956, **21**, 250—253).—Polyoxyethylene (20) sorbitan monostearate labelled with ^{14}C administered orally to rats indicated that 6 to 10% of the polyol moiety is excreted in the urine, 2 to 7% is recovered in the expired CO_2 and the remainder in the fæces. Negligible amounts of ^{14}C were found in the lymph fluid indicating that the polyol moiety recovered in the fæces had passed through the intestinal tract without absorption into the vascular system. E. M. J.

Method for measuring the strength of food materials. N. Wolodkewitsch (*Z. LebensmittUntersuch.*, 1956, **103**, 261—272).—A method is described in which a piston of known velocity (e.g., 1·4 mm. per sec.) is pressed down on to food in a container of slightly larger diameter than the piston, the food (bananas or strawberries, etc.) is forced upwards through the slit (e.g., 1 mm.). Good correlation was found between measured values and the strength of the food material in kg./sq. cm. The method is useful for fibre-free or short-fibre foods, but not for meat. E. M. J.

Determination of phosphoric acid [in foods, etc.]. H. Eschmann and R. Brochon (*Chimia*, 1956, **10**, 58—64).—A critical study is made of methods of determining P in org. materials, following oxidation to PO_4^{3-}. An improved method is described. After

hydrolysis of meta- and pyro-phosphates with H_2SO_4 and removal of Fe and Al with cupferron and ether, NH_4MgPO_4 is precipitated in the presence of enough Complexone III to hold up Ca^{2+}, etc. The precipitate is redissolved and the Mg^{2+} is titrated with Complexone with Eriochrome Black T as indicator. The error is $<0{\cdot}1$ mg. of PO_4^{3-}. (57 references.) A. B. DENSHAM.

Identification and determination of mercury in biological materials. H. Wanntorp and A. Dyfverman (*Ark. Kem.*, 1956, **9**, 7—27).—The dithizone–Versene method was tested and modified for the determination of Hg, e.g., in body tissues in case of suspected poisoning; 10—100 μg. of Hg in 25 g. of muscle, kidney, liver, etc., could be determined with a mean recovery of 97%. Ag and Cu interfered markedly with the extraction; the effect of Cu was studied further. A procedure for the identification of Hg in dithizone extract is discussed. (14 references.) E. M. J.

Rapid method for the determination of water in emulsions, ointments, pastes and viscous mixtures with the aid of a simple vacuum-drying apparatus and the "plane weighing glass" ("Planwägeglas"). A. Purr (*Fette Seifen Anstrichmittel*, 1954, **56**, 1005—1010).—The "Planwägeglas" (PW), introduced by Heidbrink (*Fette u. Seifen*, 1951, **53**, 291) consists of two flat circular, ground-glass plates (60 mm. diameter), the top one of which can be raised and lowered by means of a suitable handle and hook. This weighing device is used in combination with a new, thermostatically controlled, vacuum drying apparatus (described and illustrated) for gravimetric determinations of the water content of liquid and semi-liquid mixtures (milk, butter, cheese, chocolate-spreads, jam, fruit-pulps, glues, etc.). The substance (~100 mg.) is placed on the lower glass-plate of the dried and weighed PW, immediately covered by the top plate (to prevent evaporation), weighed, spread out into a film by raising the top plate with a rubbing motion and suspending the lower plate in the heated vacuum desiccator, over a suitable drying agent, and dried at 70°/10—12 mm. for 2—5 min. The final weighing of the dried substance is carried out with both glass plates close together to prevent water adsorption. The process, demonstrated on numerous examples, gives results within 0·10—0·15%. (32 references.) L. S.

Science of vanilla curing. J. J. Broderick (*Food Technol.*, 1956, **10**, 184—187).—The art of "curing" of vanilla developed over the centuries is reviewed comprising: chemical and technological aspects, rôle of enzymes, other factors in conditioning, effect of temp. and light, aspects of current status. E. M. J.

Preliminary investigation of the quick curing of vanilla beans. J. J. Broderick (*Food Technol.*, 1956, **10**, 188—189).—Three studies were made (*a*) of the published work on vanilla curing, (*b*) examination of hundreds of lots of conventionally cured beans in the presence of a dependable expert curer, and (*c*) an exploratory laboratory attempt at quick curing of 2 lb. of freshly picked green beans. From these limited tests, earlier work was confirmed concerning wilting, sweating, drying, conditioning and data are given. A high moisture content is essential during the sweating operation to facilitate hydrolytic enzymic activity. E. M. J.

Effect of assignment of testing materials to the paired and odd position in the duo-trio taste difference test. J. W. Mitchell (*Food Technol.*, 1956, **10**, 169—171).—In testing for flavour intensity use of the weaker material as paired samples improves discrimination. In testing for an atypical flavour use of the typical flavour as paired samples produces more correct responses than does the reverse. A refinement of the duo-trio test was suggested which takes advantage of the more sensitive assignment of materials. E. M. J.

One-tailed and two-tailed tests in organoleptic comparisons. E. B. Roessler, G. A. Baker and M. A. Amerine (*Food Res.*, 1956, **21**, 117—121).—Two tables (*a*) for paired-sample and (*b*) triangular tests are presented. The use of these tables to determine whether an experimental product differs from a standard in respect to a given character, to select capable members of a taste panel and to compare the quality or preference between two products is discussed. E. M. J.

Critical comparison of the two-sample and triangular binomial designs. F. Filipello (*Food Res.*, 1956, **21**, 235—241).—Inherent differences existing between the two-sample and the triangular designs were demonstrated. The response curves are linear, plotting logarithm of the concentration difference against % correct judgements above chance, and Fechner's law appears to be obeyed for the sucrose solutions used. (11 references.) E. M. J.

Heat resistance of a South African strain of *Clostridium botulinum*, Type B. G. G. Knock and M. S. J. Lambrechts (*J. Sci. Food Agric.*, 1956, **7**, 244—248).—The z value of this South African strain is 19·5 and the average D values in phosphate buffer at 240°F. and 230°F. are 1·07 min. and 2·93 min. respectively. The strain is therefore about equal in heat resistance to that indicated by the figures of Esty and Meyer for *C. botulinum* in calculations of min. safe processes for canned foods. E. M. J.

Determination of the thermal death rate of bacteria. S. Levine (*Food Res.*, 1956, **21**, 295—301).—The problem of determining the conditions required to thermally sterilise a system without undue exposure of the sample to the destructive action of high temp. is considered. The thermal inactivation of P.A. 3679 and *Clostridium botulinum* is discussed and the computation of the thermal sterilisation function is presented. E. M. J.

Combined effects of heat and radiation in food sterilisation. L. L. Kempe (*Appl. Microbiol.*, 1955, **3**, 346—352).—Irradiation of *Clostridium botulinum* with γ-rays from ^{60}Co increased the sensitivity of spores to the lethal action of heat, but pre-heating at 99° did not affect the lethal action of γ-irradiation. A. G. POLLARD.

Food aërosols. E. Graham (*Soap, N.Y.*, 1956, **32**, No. 3, 143-145, 195).—The development of pressurised food packaging (e.g., whipped cream mixes, salad dressings, sauces, etc.) is reviewed. J. S. C.

Cold storage of groundnuts. P. B. Mathur, M. Prasad and K. Kirpal Singh (*J. Sci. Food Agric.*, 1956, **7**, 355—360).—Shelled and unshelled groundnuts packed in gunny bags were stored at 32—35, 42—45, 52—55°F. and at room temp. 71—92°F. for nine months at R.H. 85—90% in the cold storage chambers and 50—82% at room temp. Results indicated that storage at 32—35°F. and a R.H. of 85—90% are the optimum conditions for groundnuts, the shelled nuts being stored in gunny bags or other suitable packages. (15 references.) E. M. J.

Influence of temperature and storage time on the changes occurring in foodstuffs in cold storage. J. Kuprianoff (*Kältetechnik*, 1956, **8**, 102—107).—A discussion is given of the effects of the duration of cold storage and the storage temp. on the quality of foodstuffs and of the influence on those qualities of the initial freshness of the foods prior to storage (which is governed by temp. of keeping prior to the cold storage). Graphs are given to illustrate the relationship between the retained quality of a large no. of foodstuffs (fish, fruit, meat, vegetables, fats, etc.) and the storage temp. and storage time, and from these graphs a temp. coeff. $Q_{10} = (t + 10)/t$ (where t is the storage time at given temp.) is calculated. The values of Q_{10} for each of the foods are tabulated for the temp. ranges −10 to −20° and − 20 to −30°. Graphs are also given to show the min. storage time for each of the foods at different storage temp. (18 references.) H. L. WHITEHEAD.

Apparatus for blending or mixing operations. W. Price and Sons, Ltd. (Inventor: L. Hodgson) (B.P. 739,374, 8.1.52).—When flour and water are mixed to form dough the final mixture must be of a predetermined temp., and alterations in the temp. of the constituents and of the surroundings must be accounted for. The device consists of two thermometers, one of which is immersed in the flour, the other is in the atmosphere; these thermometers are of the vapour-pressure type and one operates a pointer, the other rotates a scale behind the pointer. Movements are so adjusted that the pointer immediately indicates the temp. at which the water must be, in order that the resultant mixture shall be at the predetermined temp. The device can also operate a hot- and cold-water mixing valve so that the water is of the prescribed temp. J. A. BARNARD.

Culinary mixes. General Foods Corp. (B.P. 740,958, 18.12.53. U.S., 4.3.43).—A culinary mix (e.g., cake batter) which can be subsequently admixed with fluid (milk, etc.) with less labour, is obtained by mixing flour with atomised shortening in a liquid, supercooled state. F. R. BASFORD.

Preparation of pudding compositions. General Foods Corp. (B.P. 741,076, 6.11.53. U.S., 9.4.53).—A pudding composition, which with cold water or milk affords within a short period of time a product with similar characteristics to cooked starch pudding, is prepared by interaction of $M_4P_2O_7$ 1—4, M_2HPO_4 (M is alkali metal, e.g., Na) 0·5—4, and pre-gelatinised starch 10—30 pt. F. R. BASFORD.

[Removal of] silicone-resin surface coatings from aluminium and aluminium alloy articles [e.g., bread-baking pans]. Warwick Production Co., Ltd. (Inventor: S. C. Boyle) (B.P. 737,616, 3.7.53).—The article is subjected to the action of molten NaOH, or of a molten mixture of NaOH 90, $NaNO_2$ 1, and $NaNO_3$ 90 pt. by wt. J. M. JACOBS.

Coating a comestible substance to biscuits. A. Hughes and Sons, Ltd. (Inventor: William Wilson) (B.P. 739,187, 6.3.53).—Jam is fed on to biscuits travelling under a hopper by nozzles in the base of the hopper from which the jam is fed intermittently by a plunger. As the extrusion of jam ceases, a reciprocating arm rocks the hopper,

which can swing about the trunnions in which it is mounted, so that the nozzle moves rapidly in the same direction as the biscuit and at a higher velocity, so as to fold the depending " tail " of jam forward on to the rest of the coating which has already been applied. K. RIDGWAY.

Regeneration of activated carbon and silica from waste residues from refining sugar. K. Kojima (Japan P. 6,029 ('54). Gr. 20.9.54).—The waste residue (1 kg.) containing 61·5% of water, 18·5% of C, 15·2% of HCl-insol. SiO_2, 2·8% of Ca and Fe, 1·6% of org. impurities, and 0·4% of sugar is heated gradually to 600—650° in 220 g. of 50 Bé. NaOH and cooled to 100° to give 470 g. of powder which is added portionwise to 2 l. of boiling dil. NaOH (pH 10) and filtered to give 1900 ml. of a filtrate containing 9% of Na silicate. The insol. residue is added portionwise to 2·5 l. of boiling 5% HCl, filtered and washed with water to give 170 g. of activated C. The filtrate containing Na silicate is treated with HCl to give SiO_2 gel. SUG. IND. ABSTR. (E. M. J.).

Machine for injecting jam into articles of food, particularly doughnuts. Stephen A. Jones (B.P. 736,739, 4.8.53).—A large hypodermic-type syringe is used. K. RIDGWAY.

Dehydration of liquid compositions containing water [e.g., fruit juices]. Commonwealth Engng Co. of Ohio (Inventor: E. P. Wenzelberger) (B.P. 736,186, 24.7.53).—Fruit juices are dehydrated by freezing which causes ice to separate out, leaving a conc. juice behind. The freezing is carried out in metal canisters having two stirrers. One runs at 125 r.p.m. and scrapes ice crystals from the wall as fast as they form. The other keeps the scraped crystals in suspension, running at 800—900 r.p.m. The temp. differential between the juice and the outside refrigerant is small, about 5 to 7°F., and several stages are used. In each stage the ice crystals are clear and small, so that only water is removed, and no fruit juice solids are occluded. K. RIDGWAY.

Dehydration [concentration] of solutions by freezing. Commonwealth Engng Co. of Ohio (Inventor: E. P. Wenzelberger) (B.P. 739,825, 25.1.54).—A row of freezers with stirrers and scrapers are arranged to work at progressively decreasing temp. along the row. The contents when partly frozen are dropped on to a travelling screen, the ice being separated off and passed to a centrifuge for complete liquid removal, the liquid, e.g. fruit juice, being returned by a pump to any selected freezer in the series by one of a number of valve-controlled pipes. K. RIDGWAY.

Preparation of improved vegetable food substance. Charles Reid (B.P. 740,488, 15.6.53).—A mixture of wort (produced by grain mashing) 50 and juice from fruit and/or vegetable, e.g., apple juice 25 and carrot or beetroot juice 25 vol.-%, is concentrated, to provide a stabilised food product of sp. gr. 1·3—1·32. F. R. BASFORD.

Machine for peeling potatoes and the like. I. H. Oxford and D. L. Dike (B.P. 736,941, 13.11.53).—The device described includes a cutter which is pivoted and thus able to follow closely the contour of the potato and peel the whole surface, except the extreme ends. J. A. BARNARD.

Manufacture of potato mash. R. A. S. Templeton (B.P. 740,711, 26.2.53).—An improved (continuous) process for the prep. of dried, cellularly intact powder from cooked potatoes (or other cooked farinaceous material), suitable for reconstitution with hot water, etc., comprises adding the cooked material to partly dried product (at ~50°), to keep the moisture content below 60% (preferably 30—40%), then evaporating down to <30% of water before discharging therefrom. Completion of drying is preferably effected elsewhere. F. R. BASFORD.

[Dehydration of] food and other substances. R. A. S. Templeton (B.P. 740,745, 25.5.51).—A machine, for use in the dehydration of vegetables and fruits, especially cooked potatoes, is figured and claimed. It comprises a cooking oven through which the foodstuff passes and from which it travels through a dehydration apparatus. The operation is continuous. F. R. BASFORD.

Clarification and stabilisation of vegetable beverages containing tannin. Canadian Breweries, Ltd. (Inventor: W. D. McFarlane) (B.P. 736,565, 13.6.53).—The beverage, e.g., beer, is treated with polyvinylpyrrolidone (0·5—2 lb. per 25,000 lb. of beer), to precipitate tannins. F. R. BASFORD.

Roasting of coffee. A. Scolari (B.P. 740,786, 26.8.53. It. 29.9.52 and 8.6.53).—Coffee beans are roasted in a cylindrical pan with a perforated base by means of i.r. lamps mounted above and below the beans. The beans are agitated by paddles on rotating arms during the roasting process, whilst a gentle air current is drawn downwardly through them by a fan. After roasting, a more rapid air current cools the beans, which are discharged through a slot into a chute. The beans are roasted at 180° at a power consumption of 1 kw./lb. of beans for an 11 lb. batch. K. RIDGWAY.

Production of small lactose crystals. N.V. Lijempf (Inventor: R. de Vletter) (B.P. 740,255, 7.4.53).—Lactose solution is concentrated to <30 (15—20) wt.-% of water, without surface crystallisation, optionally in presence of a η-depressant (glucose, galactose, cane sugar, and/or invert sugar), then the hot concentrate is quickly cooled (at pH >8·5), without permitting crystallisation. The cooled mass is then subjected to agitation, to give small crystals of lactose (1μ), bacteriologically sterile and suitable for use in the inoculation of condensed milk, etc. F. R. BASFORD.

Apparatus for making ice-cream confections. Eskimo Pie Corp. (Inventor: C. K. Nelson) (B.P. 740,831, 9.4.53).—Metal containers filled with ice-cream mix are moved along refrigerant tubes in a vertical helix with small pitch. At the top of the machine the frozen block is detached from the metal container, which re-enters the machine whilst the block falls on to a conveyor belt. K. RIDGWAY.

Dry nisin preparation. Aplin & Barrett, Ltd. (Inventor: H. B. Hawley) (B.P. 738,655, 9.5. and 23.7.52).—Nisin-containing fluid, e.g., a culture of milk or a milk product is adjusted to pH 3, and heated to ⩽90°, then freed from curd. After concentration (spray drying), ~50 wt.-% of edible, absorbent solid (meat, fish powder, vegetable powder, wheat flour, cornflour, soya flour, arrowroot, starch, rice powder, pea powder, or curd from the process) is added (optionally prior to spray-drying), to provide a dry prep., suitable for incorporation into foodstuffs, the nisin present minimising subsequent spoilage on storage. F. R. BASFORD.

Stuffed food products comprising a cellulosic casing. American Viscose Corp. (B.P. 738,036, 5.3.53. U.S., 6.5.52).—Sausage coverings are composed of a cellulosic layer having a thickness of 0·0021 in., coated with a polymer such as a synthetic rubber, e.g., of the Buna type, or vinylidene resins, or blends of the two to give a composite layer 0·0028—0·0047 in. thick, having a water permeability of 0·000387—0·000392 g./sq. cm. per 24 hr. at 58% R.H. and 75°F. This prevents undue weight loss by evaporation, whilst not allowing water to accumulate under the skin. K. RIDGWAY.

Manufacture of artificial skin structures, e.g., sausage skins, from animal skin material. Anstalt Unda (B.P. 740,742, 19.9.50. Switz., 23.9.49).—Animal skin material is fed into the annular space between a conical outer casing and an inner conical member, the inner member carrying a helical thread. The apex of the conical assembly is an annular die through which the skin material is forced. By the screw action, the fibres are caused to lie tangentially to a circle perpendicular to the axis of the extruded tube, thereby giving a more even product, and, by enabling a lower working pressure to be used, prolonging the life of the die. K. RIDGWAY.

Production of fat emulsions. J. A. Benckiser G.m.b.H. Chemische Fabrik (B.P. 739,270, 8.9.52. Ger., 7.9.51 and 7.2.52).—Blood plasma (obtained by centrifuging blood treated with coagulation inhibitors, e.g., polymeric phosphates) is used as the emulsifying agent for the prep. of margarine or medicinal creams, or to facilitate the incorporation of fat into sausages. J. M. JACOBS.

Preparation of nutrient fat emulsions. Merck & Co., Inc. (B.P. 736,433, 27.1.53. U.S., 6.2.52).—Fat (vegetable oil, fluid at 0—15°, e.g., sesame or olive oil) 20—30 [optionally dissolved in an org. solvent, e.g., an alcohol] and lecithin 0·5—2% (optionally as a solution) are dispersed (at 43—45°) in an aq. solution of sugar 5%, e.g., dextrose or levulose, to give (after removal of solvent) an aq. emulsion (particle size 0·5—1 μ.) suitable for intravenous injection, e.g., in cases of illness, injury or surgical operation. F. R. BASFORD.

Chocolate and like enrobing machines. W. D. Meagher and G. Meagher (B.P. 736,810, 20.10.52).—When chocolate coatings are applied to biscuits, ice-cream, etc. by passing the objects to be coated through a curtain of chocolate, the chocolate must be hot enough to be of the required viscosity but not too hot or the coating may not be satisfactory. To maintain the temp. of the chocolate emerging from a fish-tail jet to form the curtain at the required temp., a thermometer in the jet is made to operate a relay. This controls the chocolate reservoir heaters and also a valve which allows cold water to circulate around the chocolate, thereby counteracting the thermal lag of the heaters and maintaining the chocolate at the desired temp. The thermometer can be set manually to operate at any desired temp. J. A. BARNARD.

Chocolate coating machines. W. Brindle (B.P. 736,867, 10.11.52).—Molten chocolate from a reservoir is raised by two wheels to a tank from which it falls in a curtain. The objects to be coated are passed on a wire conveyor belt through this curtain, thereby coating the top and sides of the object. The excess chocolate falls through the belt, is collected by an inclined plane and forced back on to the bottom of the objects by a roller. The objects then pass from the

belt over another roller which removes the excess chocolate from their undersides and on to a cooler belt. There is provision for lifting the dispensing tank away from the feeder wheels and cleaning the wire belt by an air blast. J. A. BARNARD.

Rotary grinding machine for chocolate and similar masses. F. Knops, J. Thouet and R. Knops, trading as Josef Thouet K.G. (B.P. 739,982, 20.4.54. Ger., 3.12.53).—A grinding machine for more rapid and efficient conching of chocolate masses has a cylindrical drum containing a rotor which carries kneading plates, conveying plates and grinding drums, with scraper blades at its ends. The chocolate is pressed on to the drum surface, ground and scraped off and as it falls, strikes horizontal bars carried by the rotor, which break it up and allow prejudicial aroma to be carried away via an upper ventilator. The lower part of the drum is water jacketed so that the mass being treated can be maintained at the desired temp. K. RIDGWAY.

Sieving or mashing foodstuffs and the like. W. V. and D. Dawkings (B.P. 736,533, 5.3.53).—An imperforate second cylinder is mounted on a shaft driven by epicyclic gearing to travel round the inside of a larger perforated cylinder, and in close contact with it. According to the gearing, contact may be rolling or rubbing. The foodstuff is forced through the perforations into a collector. The driving force may be a handwheel or a motor, depending on the capacity of the installation. K. RIDGWAY.

Vitamin preparations. Vitamins, Ltd. (Inventor: Joseph Green and F. C. Scott) (B.P. 739,157, 14.7. and 16.12.52).—Fish liver oil (or concentrate) or synthetic vitamin A and/or D-concentrate is absorbed on finely ground seed of the *Leguminosæ* family, e.g., pea (*Pisum sativum*), to give a free-flowing vitamin prep. F. R. BASFORD.

Treatment of food. B. L. Sarett (B.P. 740,379, 17.2.53).—A food product, e.g., egg constituent, potato, cereal, or coconut, containing aldose and material capable of reacting therewith to give an undesirable compound is stabilised by treating with O_2 in presence of water and an oxidase (to convert aldose into corresponding sugar acid). F. R. BASFORD.

3.—SANITATION

Determination of fumigants. XXIII. Recovery of hydrogen cyanide from fumigated insects. H. J. Bhambhani (*J. Sci. Food Agric.*, 1956, **7**, 276—281).—In determinations of sorption and recovery of HCN from fumigated insects *Calandra granaria*, L. and *C. oryzæ*, L., there was little discrepancy when the fumigated insects were ground before distillation; a solution of pH 3·2 was used to hydrolyse cyanhydrins formed in the insects. E. M. J.

Fumigation of agricultural products. XIV. Treatment of peas and beans with methyl bromide. O. F. Lubatti and R. E. Blackith (*J. Sci. Food Agric.*, 1956, **7**, 343—348).—Peas and beans unlike onion seed and groundnuts are resistant to damage by methyl bromide fumigation even if the seeds contain up to 19% of water. The damage caused by the fumigant was essentially the same whether the seed was dry or damp. The seeds deteriorated, if stored at $>\sim$15% moisture content, from the action of the moisture itself. Peas and beans that survive damp storage or methyl bromide fumigation give essentially the same yield as do untreated seeds. The staining test with a 2% solution of " tetrazolium salt " gave significant indications of the influence of fumigation damage and of damp storage, etc. E. M. J.

Simple method for detecting contamination of wheat by rodent urine. J. W. Laakso, M. Ferrigan, M. O. Schultze and W. F. Geddes (*Cereal Chem.*, 1956, **33**, 141—145).—A method is described for detecting wheat contaminated with rodent urine based on liberation by urease solution of NH_3 from the urinary urea and detection by Nessler reagent. Wheat kernels dipped into a 0·1% solution of urea or into 2% aq. rat urine gave a positive reaction after draining and drying. A free adult rat contaminated $\sim$10,000 kernels daily when water was supplied. S. C. JOLLY.

Pests of stored products in New Zealand. II. Family *Ptinidæ* (*Coleoptera*). K. A. J. Wise (*N.Z. J. Sci. Tech.*, 1956, **37, B**, 503—508).—The Ptinid beetles infesting stored products in New Zealand are *Mezium affine*, *Niptus hololeucus*, *Trigonogenius globulus*, *Ptinus tectus* and *P. hirtellus*; all are introduced species. J. S. C.

Search for new insecticides. II. S. S. Tiwari and B. N. Tripathi (*J. Indian chem. Soc.*, 1956, **33**, 214—216).—Six chloroacetates of different (substituted) phenols are prepared by the action of chloroacetyl chloride on the appropriate phenols. The esters are rearranged by treatments with anhyd. $AlCl_3$ to give *o*-hydroxyketones for studying their insecticidal activity. Many esters and ketones are characterised but no insecticidal tests are reported. I. JONES.

Insecticidal properties of aryloxy*cyclo*propanecarboxylic esters. M. Julia, G. Viel and M. Chancogne (*C. R. Acad. Sci. Paris*, 1955, **241**, 1353—1355).—The compounds studied were of the general structure X-substituted phenoxy*cyclo*propylcarboxylic esters of alcohols ROH, X and R being varied. The variants of X included F, Cl, Br, I, NO_2, CH_3 and OCH_3 in the *p* position, Cl in *o* and *m* positions, 2 : 4-Cl_2, 2 : 4 : 5-Cl_3, 2 : 4 : 6-Cl_3, *p*-Cl *o* CH_3, and naphthyl. R variants were the *n*-alkyl series up to C_9, *cyclo*hexyl, *cyclo*pentyl, and C_2H_4Cl. The median lethal dose of each product was determined by the toxic film method with *Calandra granaria* as test insect. The highest figures were with X = *p*-NO_2 in the first series of variants and R = $C_{12}H_{25}$ in the second. Tests on the domestic fly and on *Aphis fabæ* were also made. J. S. C.

Some esters of dithiophosphoric acid for use as insecticides. B. A. Arbuzov, K. V. Nikonorov and G. M. Vinokurova (*Izv. Akad. Nauk SSSR*, 1955, 672—675).—Reference is made to earlier investigations of esters of dithiophosphoric acid of the general formula $(RO)_2P(S)\cdot S\cdot CH(R')XR''$, where X = O or S, and R, R', R'' are alkyl or aryl. (Hoon and Moss, *Chem. Abstr.*, 1952, 8322); *Chem. Z.*, 1953, **14**, 2182.) In this paper further progress is described and compounds are characterised. By condensation reactions of *OO*-dialkyl esters of phosphorothiolothionic acid with MeCHO and ethyl mercaptan—$(RO)_2P(S)\cdot SH + CH_3\cdot CHO + HS\cdot C_2H_5 \rightarrow (RO)_2P(S)\cdot S\cdot CH(CH)_2\cdot S\cdot C_2H_5 + H_2O$—five compounds were obtained; two of these when tested proved to be very strong insecticides. A. L. B.

Tests with organic phosphorus insecticides for fly control. W. T. Johnson, G. S. Langford and B. S. Lall (*J. econ. Ent.*, 1956, **49**, 77—80).—When used as sweetened baits, Diazinon, Am. Cyanamid 4124, chlorthion, Pirazinon and Bayer L13/59 all gave very satisfactory control of house flies. Malathion, Diazinon and Am. Cyanamid 4124 either with or without sugar were also very efficient wall sprays. A. A. MARSDEN.

Separation of *Anabasis aphylla* L. alkaloids. A. S. Sadykov and É.Kh. Timbekov (*Zh. prikl. Khim.*, 1956, **29**, 148—152).—The anabasine content of kerosene extracts of *Anabasis* alkaloids is determined, and a corresponding amount of a solution of HCl in kerosene is added to the extract, when anabasine hydrochloride separates out, leaving lupinine, aphylline and aphyllidine in solution. The crude hydrochloride contains 50—60% of anabasine, and is more toxic to insects than is anabasine sulphate. (15 references.) R. TRUSCOE.

Methods for the study of blowfly populations. I. Bait trapping. Significance limits for comparative sampling. J. MacLeod and J. Donnelly (*Ann. appl. Biol.*, 1956, **44**, 80—104).—Results obtained with bait traps on different types of pasture are presented and examined statistically. Methods of sampling are discussed. A. H. CORNFIELD.

Control of house flies in dairy barns with special reference to Diazinon. E. J. Hansens (*J. econ. Ent.*, 1956, **49**, 27—32).—Of several phosphatic insecticides tested for house fly control, Diazinon was by far the best material, followed by Dow ET-14 (*OO*-dimethyl *O*-2 : 4 : 5-trichlorophenyl phosphorothioate), Am. Cyanamid 4124, Chlorthion, Dow ET-15 (*O*-methyl *O*-2 : 4 : 5-trichlorophenyl phosphoramidothioate), and malathion in that order. Of the dry baits tested, Diazinon and Bayer L13/59 were best. Baits failed to control biting flies. No choline-esterase inhibitor, and no effect on flavour appeared in milk from cows housed in sheds treated with Diazinon and house flies were controlled for $<$2 months. House flies were killed partly by fumigation and partly by direct contact with Diazinon. A. A. MARSDEN.

Insecticides used to control house fly larvæ. W. W. Sampson (*J. econ. Ent.*, 1956, **49**, 74—77).—Field and laboratory tests showed that at concn. of 0·125%, endrin, heptachlor, lindane and parathion were all highly effective as house fly larvicides. Diazinon, dieldrin, DDT and phenothiazine were nearly as effective (at 0·25%), followed by chlordane, malathion and Na pentaphenate (at 0·5%). Factors influencing the effectiveness of the larvicides are discussed. A. A. MARSDEN.

Fate of γ-benzene hexachloride in normal and resistant house flies. II. F. R. Bradbury and H. Standen (*J. Sci. Food Agric.*, 1956, **7**, 389—396; cf. J.S.F.A. Abstr., 1955, i, 388).—By means of radioactive ^{14}C-labelled benzene used in the prep. of BHC isomers, quant. determinations were made of the water-sol. metabolites excreted by normal and resistant house flies after 24 hours' exposure to the insecticidal vapour. Factors contributory to the resistance to poisoning by γ-BHC are: γ- (and α-) isomers are readily metabolised into water-sol. materials and excreted, and resistant flies absorb

less BHC. The amount of γ-BHC in a resistant house fly is ½ of that in a normal fly 4 hours after a 15-min. exposure to the vapour. E. M. J.

[Comparative] stability of allethrin and pyrethrins. S. K. Freeman (*Soap, N.Y.*, 1956, **32**, No. 2, 131, 133, 135; No. 3, 150—151, 153, 166—167, 170—171, 173, 197).—The action of heat and u.v. radiation on allethrin and natural pyrethrins was quant. compared and the effects of a five-year storage period examined chemically. Insecticidal potency was also evaluated. In general, it was found that allethrin showed considerably higher stability than the natural insecticides. (31 references.) J. S. C.

Pyrethrins–piperonyl butoxide as a residual treatment against insects in elevator boots. F. L. Watters (*Cereal Chem.*, 1956, **33**, 145—150).—Five weeks after treatment the no. of live adults and pupæ of the confused flour beetle (*Tribolium confusum*) and the flat grain beetle (*Læmophlœus pusillus*) in elevator boot stocks were significantly reduced by treatment with 2·5% pyrethrins and 25% piperonyl butoxide (1 ml. insecticide per 50 g. stock). Movement to other milling equipment was reduced by paralysing *T. confusum*. Loaves baked from the first sample of flour to pass over a treated boot had a faint odour of the insecticide, but this was not noticeable with subsequent samples. S. C. Jolly.

Prevention of evaporation from water reservoirs. Anon. (*J. Agric W. Aust.*, 1955, **4**, 194).—Under laboratory conditions a surface film of cetyl alcohol on water reduced evaporation by 80%. On a 2-acre reservoir evaporation was reduced by 30%. A. H. Cornfield.

Preliminary report on a one-hour presumptive test for coliform organisms. G. V. Levin, V. R. Harrison and W. C. Hess (*J. Amer. Wat. Wks Ass.*, 1956, **48**, 75—80).—The standard method for identifying coliform organisms in water supplies requires the production of CO_2 from lactose, and normally requires 48—72 hr. The one-hour presumptive test involves the use of lactose labelled with radioactive ^{14}C and detection of ^{14}C in the evolved gas. The test water, and ^{14}C-lactose broth at 37° are aërated, the exhaust gas is passed through a paper fibre pad moistened with $Ba(OH)_2$, and the pads are periodically assayed for radioactivity. Preliminary results indicate that less than 20 coliform cells can be detected in one hour. Refinements in technique are envisaged, and it is also suggested that the use of ^{35}S in place of ^{14}C would detect a single bacterium in a few minutes. The potential wide applications of a finalised technique are discussed. G. Helms.

Chronic toxicity of cadmium and hexavalent chromium in drinking water. C. F. Decker, C. A. Hoppert and R. U. Byerrum (*J. Amer. Wat. Wks Ass.*, 1956, **48**, 89—90).—Preliminary results (6 months) with albino rats and dogs ingesting water containing 0·1 to 10 p.p.m. of Cd indicate no adverse effects on bodyweight or growth rate, food and water intake, and hæmoglobin content of the blood. Similar tests with 1—25 p.p.m. of CrO_4'' show no adverse effect on growth rate or food and water intake but a slight reduction in the hæmoglobin value of the animals ingesting the water containing 25 p.p.m. of CrO_4''. Long term exposure is being carried out. G. Helms.

Effects of water quality on various metals. L. Streicher (*J. Amer. Wat. Wks Ass.*, 1956, **48**, 219—238).—A wide variety of corrosion problems encountered in municipal water supplies from the Colorado River are described and illustrated for a number of metals. Experience indicates that corrosion problems can be reduced by avoiding connexions between dissimilar metals; using insulated couplings; avoiding complete softening of household water by zeolites especially in relation to hot water systems; eliminating zinc stars and brass sand rings from water meters; by greasing meter parts during servicing; and by using Na hexametaphosphate during periods of changing water quality. G. Helms.

Snail and clam infestations of drinking-water supplies. W. M. Ingram (*J. Amer. Wat. Wks Ass.*, 1956, **48**, 258—267).—The literature relating to snails in drinking-water supplies is fully reviewed; pipe-dwelling snails and clams are discussed, and the life cycles given for *Bythinia tentaculata* (faucet snail) and *Dreissensia polymorpha* (clam) are described. Sections deal with points of entry of the molluscs into water supply and methods for preventing entry. Elimination of molluscs from distribution lines by means of molluscacides, viz., Cu, Cl_2 and Na pentachlorophenate results in taste and odour development from decaying molluscs, and scraping devices and flushing of distribution mains seem preferable. G. Helms.

The biochemical oxygen demand test: a note on variable results from the use of stored standard dilution water. A. B. Wheatland and R. G. Smith (*Analyst*, 1955, **80**, 899—900).—Experiments have shown that the common practice of keeping a stock of standard dilution water may give rise to B.O.D. values very different from those obtained when freshly prepared dilution water is used. Analysis of the stored dilution water showed that practically all the NH_3 originally added had been oxidised to NO_3', indicating the probable presence of nitrifying bacteria which encouraged nitrification in the diluted sewage during the five-day test. Further experiment showed that standard dilution water may be stored for a short time in vessels cleaned with chromic acid and thoroughly rinsed, but the practice of "topping up" the stock should be avoided. A. O. Jones.

Treatment of crude benzene hexachloride. Farbenfabriken Bayer A.-G. (B.P. 738,032, 16.2.53. Ger., 15.2.52).—Odour and taste of crude benzene hexachloride are improved by stirring with an aq. solution of an emulsifier (0·1—1%) e.g., alkylsulphonate, alkyl sulphate, alkarylsulphonate, soap, condensation product of a high-mol. fatty acid, or product obtained by interaction of ethylene oxide with a high-mol. alcohol or amine. F. R. Basford.

Production of an insecticidally-active substance containing benzene hexachloride. P. Marron and J. Nebrera (B.P. 740,761, 4.12.52. Spain, 9.10.52).—Benzene hexachloride is recrystallised from petroleum hydrocarbon (after fusion) and is then saturated (without dissolving) with terpene hydrocarbon (**I**) $C_{10}H_{16}$ which has been freed from harmful resins, etc. (by treatment with H_2SO_4). There is subsequently recovered a **I**-coated benzene hexachloride (mixed isomers), which is then exposed to air, to effect oxidation and give an insecticidal mass. F. R. Basford.

New basic esters of phosphorus-containing acids. Imperial Chemical Industries, Ltd. (Inventor: R. Ghosh) (B.P. 738,839, 19.11.52).—Compounds $OR(OR^{I})\cdot PS\cdot OR^{II}\cdot NR^{III}R^{IV}$ or $OR(OR^{I})PO\cdot SR^{II}\cdot NR^{III}R^{IV}$ are claimed as pesticides (R and R^{I} are alkyl, R^{II} is alkylene optionally interrupted by O, S or NR^{V}, R^{III} and R^{IV} are alkyl or together with N form a heterocyclic ring, and R^{V} is alkyl). In an example, Na is dissolved in a mixture of benzene and $NEt_2\cdot[CH_2]_2\cdot OH$, then after cooling, $(OEt)_2PO\cdot Scl$ is added. The solution is boiled during 4 hr., filtered from NaCl, and distilled, to give *OO'-diethyl S-(2-diethylaminoethyl) phosphorothiolate*, b.p. 97°/0·2 mm., n_D^{21} 1·4732. F. R. Basford.

Phosphorus-containing insecticidal esters. Norddeutsche Affinerie (Inventors: W. Perkow and H. Koddebusch) (B.P. 739,726, 5.2.53).—Compounds $(OR)_2PO\cdot XR'$, useful as insecticides, are obtained by interaction (without applied heat) of $P(OR)_3$ with $R''SX'$ or $CX'CHO$ optionally in an inert solvent (R is alkyl of 1—10 C, R' is alkyl dihalogenovinyl, aryl, or aralkyl optionally carrying halogen or NO_2, R'' is as R' other than dihalogenovinyl, X is O or S, X' is halogen). Thus, a solution of Et_3PO_4 in benzene is added portionwise to chloral in benzene with cooling, then the mixture is distilled, to give *diethyl dichlorovinyl phosphate*, b.p. 113—115°/2 mm. F. R. Basford.

Sterilisation of draw-off taps or cocks for sterile liquid. Chas. F. Thackray, Ltd. (Inventor: E. Rothwell) (B.P. 738,743, 17.12.51).—A tap for sterile water has a hand- or foot-operated spindle acting on a washer to supply or retain the sterile water. In addition, a steam supply controlled by a separate cock can be caused to deliver sterilising steam through a tube, past the washer assembly and out of the tap outlet. Thus thorough sterilisation of the parts of the tap which are open to the atmosphere is possible on each occasion that sterile water is to be drawn. K. Ridgway.

4.—APPARATUS AND UNCLASSIFIED

Novel glass vacuum concentrator. R. G. Hansen and A. F. Robbins (*J. Dairy Sci.*, 1956, **39**, 612).—A highly efficient all-glass vacuum concentrator is described for freeze-drying a variety of biological materials. The method of sealing the evaporating surface to the cold condensing surface is novel. S. C. Jolly.

Filling of chromatographic tubes with alumina. B. Wendt and C. Lehmberg (*Ernährungsforschung*, 1956, **1**, 162—164).—A simple method is described for securing uniform packing of the Al_2O_3 with the use of suction provided by a laboratory water-pump. P. S. Arup.

Air-sterilising apparatus. Gaskell & Chambers, Ltd. (Inventor: R. Gretton-Lowe) (B.P. 740,653, 13.8.53).—Air to be admitted to the upper part of a liquid container for, e.g., beer or milk, from the lower end of which the liquid is being dispensed, is sterilised by being passed by suction through a heating coil, and bubbled through water. The water is constantly renewed so that any scum washed from the air is removed. The whole assembly of heater and bubbler is mountable on a wall by means of brackets, and has a large inspection window at the front. K. Ridgway.

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