JOURNAL
OF THE
SCIENCE OF FOOD AND AGRICULTURE

Published by the Society of Chemical Industry

Volume 6 | No. 1 | January, 195[illegible]

Journal of Applied Chemistry

The following papers are appearing in the January, 1955, issue of the *Journal of Applied Chemistry*

The corrosion of tin by aqueous solutions of ammonia
By S. C. Britton and D. G. Michael

The corrosion of tin in solutions of sodium alkyl sulphates
By T. K. Ross

Operation of the Thylox process with coal gas containing hydrogen cyanide
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Chromium hexacarbonyl. II. Chromi carbonyl as a fuel additive
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Journal of the Science of Food and Agriculture

Vol. 6 London 1955

SOIL FUMIGATION. III.*—The Sorption of Ethylene Dibromide by Soils at Low Moisture Contents

By PETER WADE

Isotherms of ethylene dibromide sorbed on two soils have been plotted at relative humidities between 0 and 98% of saturation. The sorptive capacities of the soils (an organic soil and a clay) decreased with increasing humidity, and the shape of the isotherms obtained changed from Type II (Brunauer, Deming, Deming & Teller[1] classification of isotherms) on the dry soils, becoming similar to Type III isotherms at humidities above 50%. The measurements were made with the aid of a helical spring balance, the construction of which is described.

Introduction

In the first paper in this series[2] an account was given of an investigation of the sorption of ethylene dibromide by three types of soil at moisture contents in the field range. Some further measurements have since been made on two of the soils at lower moisture contents by means of a helical spring balance. The apparatus was similar in principle to that used by Stark[3] in his investigation of the sorption of chloropicrin by soils.

Experimental

The spring balance was wound from 30-s.w.g. soft copper–beryllium-alloy wire and had 29 turns each of 23 mm. diameter. After being annealed at 315° for one hour the spring had a sensitivity of 5·86 cm./g. The spring was suspended from the hook A of the sorption tube illustrated in Fig. 1. A light aluminium bucket, 25 mm. in diameter and 5 mm. deep, weighing 0·4 g. and attached by fine copper–beryllium-alloy wire to the lower end of the spring, was used to carry the soil sample. The amount of fumigant sorbed by the soil sample was measured by observing the extension of the spring with a cathetometer reading to 0·01 mm. The minimum change in weight possible to detect was thus of the order of 0·2 mg.

Liquid ethylene dibromide was introduced into the apparatus *via* the straight-bore tap by means of a calibrated micrometer syringe fitted with a 20-cm. steel needle. The liquid was measured on to a strip of filter paper looped from two hooks at the lower end of the tube carrying the tap and allowed to evaporate.[2] When equilibrium was established between the fumigant in the vapour phase and that sorbed on the soil sample a further amount of ethylene dibromide was measured into the apparatus and the process repeated until an equilibrium concentration in the vapour phase of about 80 mg./l. was reached. The concentration in the vapour phase was calculated from the

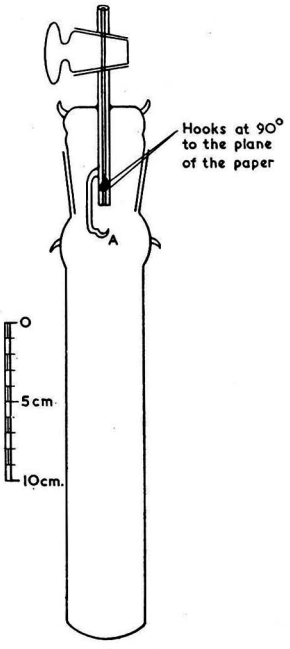


FIG. 1.—*Design of the sorption tube*

* Part II: *J. Sci. Fd Agric.*, 1954, **5**, 288

difference between the amount of fumigant introduced into the apparatus and the amount sorbed by the soil. The amount of fumigant introduced at each stage varied from 15 to 25 mg. according to the sorptive capacity of the soil.

The temperature of the apparatus was controlled by immersing the tube to just below the level of the tap in a water bath, the temperature of which could be regulated to within $\pm$ 0·05° of the desired temperature. All the measurements described in the present paper were made at 20°.

Control of the humidity of the air inside the sorption tube by means of sulphuric acid solutions was found to be impracticable, since measurements made by using a gas-sampling technique[2] in the absence of soil showed that, when the solution contained a high proportion of sulphuric acid, equilibrium between the ethylene dibromide in the vapour phase and that in solution was reached only after several hours. It was found that soil samples placed in the bucket and sealed into the apparatus in the absence of any humidity control showed small changes in weight during the first 5–6 hours, but no further changes were observed after standing for 18–24 hours. The soil samples were therefore placed in the apparatus overnight before sorption measurements were to be made. Usually 1-g. samples of soil were used in plotting an isotherm, and the change in the moisture content of the sample by evaporation or sorption of water vapour was small, being at most about 0·5%.

Measurements have been made on a clay soil (Bones Close) and on a soil with a high content of organic carbon (Black Fen). The compositions of these soils have been given in Part I.[2] A range of samples of varying moisture content were prepared by drying moist soil (passing a 2-mm.-mesh sieve) in a stream of warm air for varying periods of time. Thoroughly dry samples were prepared by drying under vacuum over concentrated sulphuric acid for one week.

Results

The initial rate of sorption of ethylene dibromide by the soils was rapid, gradually falling off and becoming imperceptible over a period of 30 minutes after 15–120 minutes according to the amount sorbed. A further increase in the amount sorbed (of the order of 3–6% of the total amount sorbed) was noted after 24 hours, in agreement with the results previously obtained at moisture contents in the field range. Equilibrium in the present experiments was taken as the amount sorbed when the rate of increase became imperceptible during 15–30 minutes.

The isotherms obtained on the Black Fen soil at various moisture contents are shown in Fig. 2. A similar series of curves were obtained with the clay soil. It has been shown previously (Part I, Fig. 6) that the sorptive capacity of the soils for ethylene dibromide increased rapidly with decreasing moisture content at moisture contents below the usual field range. The present results show this increase to continue until the soils are in equilibrium with a relative humidity of 0%. At the lowest moisture content the isotherms obtained were sigmoid, or Type II in the B.D.D.T. classification,[1] but as the moisture content increased the shape of the isotherms changed, becoming similar to Type III at moisture contents in equilibrium with relative humidities above 50%.

One isotherm was obtained on the Black Fen soil at a moisture content of 32%, corresponding with a relative humidity of approximately 98%. Attempts to carry out measurements at still higher moisture contents were unsuccessful, as distillation of water from the soil to the walls of the apparatus occurred.

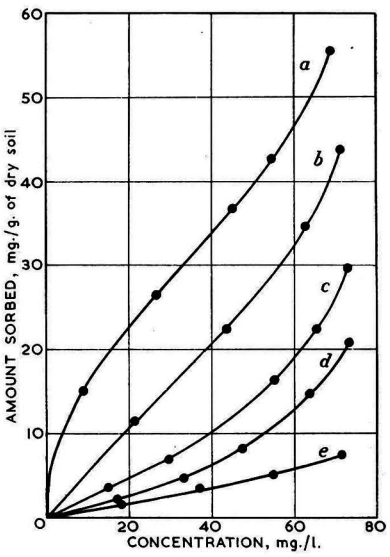
Discussion

The apparatus described above is limited in its applications to measurements on soils having an appreciable sorptive capacity under the conditions of the experiment, and to investigations where the small uncertainty in the final moisture content of the sample is not important. Within these limitations the apparatus provides a convenient method for measuring the sorption of ethylene dibromide by soils at low moisture contents. The isotherms obtained with it have been found to be closely reproducible.

The amount of fumigant sorbed by a soil of a given moisture content at a fixed concentration was found to be less when measured by the present method than when determined by the

FIG. 2.—*Sorption isotherms of ethylene dibromide on Black Fen soil, measured at 20°*

Curve	Moisture content, %	Approx. r.h., %
a	0	0
b	8	10
c	13	50
d	20	90
e	32	98



analytical technique used in the earlier investigation (e.g. compare Fig. 2 curve '*e*' with the corresponding isotherm I in Fig. 5 of Part I). This difference is partly caused by the different conditions taken as equilibrium in the two methods, the remaining difference probably being an artifact.

The change in shape of the isotherms from Type II to Type III as the moisture content of the soils increased is similar to the change in shape observed by Stark[3] for the isotherms of chloropicrin sorbed on soils at increasing moisture contents. The change can be explained by the Brunauer[1] theory of multimolecular adsorption as being caused by a change in the heat of adsorption of the first layer of fumigant molecules. Some change in the heat of adsorption would be expected as the moisture content of the soils rises since the surface of the soil particles will become covered with an increasing number of layers of water molecules, the fumigant molecules being subsequently sorbed on top of the water layer.

The observed high sorptive capacity of the dry Black Fen soil for ethylene dibromide is not in agreement with Stark's observation that a dry muck soil had a low sorptive capacity for chloropicrin. The shapes of the isotherms obtained on the dry soils (Type II in the present case, Type III obtained by Stark) are also at variance.

Acknowledgment

This investigation has been carried out with the aid of a grant from the Agricultural Research Council, whose assistance and interest are hereby acknowledged.

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Received 19 May, 1954; (amended manuscript) 22 July, 1954

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THE FREE AMINO-ACIDS OF FISH. I.—Taurine in the Skeletal Muscle of Codling (*Gadus callarias*)

By N. R. JONES

Taurine is present in the free amino-acid fraction of codling muscle. Considerable losses of the amino-acid occur during storage in ice. These apparently result from the combined actions of 'drip' on gutting and leaching by ice-melt water.

Introduction

It is only in comparatively recent years that the free amino-acid fractions of the nitrogenous extractives of fish muscle have been at all exhaustively examined, although their relation to palatability is well recognized. Their presumed participation in the 'browning' reactions that occur frequently in processes of salt curing and dehydration lends added interest to such studies.

Shewan[1] demonstrated the presence of a number of amino-acids in the basic nitrogenous fraction of cod extractives. His method of separation on 4½%-cross-linked sulphonated-polystyrene cation-exchange resin columns[2] represented a considerable advance in the field. Shewan *et al.*[3] showed that the basic extractives of the related species haddock (*Gadus aeglefinus*) are similar to those of codling. The present study, which has demonstrated the importance of a more acidic free amino-acid fraction, resulted from a chromatographic investigation into the quantitative relations between the free amino-acids in fresh and iced codling muscle. A short preliminary report of some of this work has already appeared.[4]

Experimental

Amino-acid methods

Material.—Codling were line-caught in Aberdeen Bay by the Research Vessel *Keelby*. This ensured even batches of fish from the same feeding ground for each experiment. Those used for experiment were 18–24 inches in length. Fish other than the fresh controls were killed, gutted and packed in ice in boxes under conditions simulating those in the fish trade. They were re-iced as became necessary. Fish for fresh controls were landed alive and maintained in aerated sea-water tanks until killed by decapitation.

Sampling.—Fish were skinned and filleted and 10 g. of muscle was immediately dissected from the anterio-dorsal part of the fillet. The flesh was homogenized into 32 ml. of ethanol and the homogenate filtered. The residue was re-extracted with 80% (v/v) aqueous ethanol and filtered, this process being repeated twice. Filtrates were combined and made up to 250 ml. with 80% ethanol. (This procedure assumed 80% of water in the muscle. Moisture determinations were carried out to correct subsequent calculations on the 80% water basis.) Chloroform (75 ml.) was added to 25-ml. aliquots of the aqueous ethanol extract, and the resulting emulsion shaken for five minutes before separation. The upper, aqueous layer contained the free amino-acids.[5] A 4-ml. aliquot of the aqueous layer was freeze-dried and the preparation stored over phosphorus pentoxide under high vacuum at 0°.

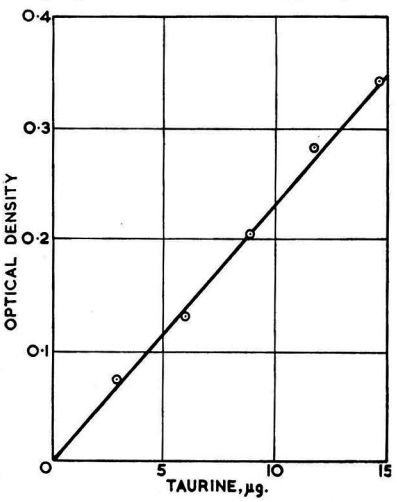

FIG. 1.—*Standard curve under experimental condition*

Chromatography.—Freeze-dried extractives were dissolved in 400 µl. of glass-distilled water, and a 5–20-µl. aliquot was placed in successive 0·2-µl. droplets at a corner of an 8-inch square of Whatman No. 1 filter paper. Batches of sheets were placed on a frame[6] for two-dimensional chromatography in phenol–ammonia and collidine–lutidine.[7] Another solvent, used for one-dimensional chromatograms, was butanol–acetic acid.[8]

Estimation.—The papers were air-dried after treatment with each solvent and sprayed on both sides with 1% ninhydrin in wet butanol. Colour was developed at 15° in darkness over 2 days. Spots were then cut out and eluted into 2 ml. of 50% aqueous acetone, blanks of equivalent adjoining area being similarly treated. A standard curve constructed from levels of 3–15 µg. of taurine run under parallel conditions and read with a Hilger 'Spekker' photoelectric absorptiometer micro-cell attachment at 570 mµ is illustrated (Fig. 1). Levels of taurine

in extracts giving about 10 μg. on the paper could be estimated to $\pm$ 7% by this method.

Method for ' extractable ' nitrogen determination

A modification of the conventional Kjeldahl method was used. Fish fillet (1·0 g.) was homogenized into 4·2 ml. of 5% trichloroacetic acid and filtered. Aliquots were heated at 300° in resistance-glass tubes with 1 ml. of a mixture comprising 1 g. of catalyst (32 g. of potassium sulphate + 5 g. of mercuric sulphate + 1·4 g. of selenium dioxide) per 2 ml. of sulphuric acid, 2 drops of hydrogen peroxide being added towards the end of the digestion. Aliquots of the diluted digest were distilled in a Hoskins micro-distillation apparatus with a solution of 10% sodium thiosulphate in 40% potassium hydroxide solution. Ammonia was absorbed in borate–methyl red indicator solution for direct titration with 0·008N-hydrochloric acid.

Examination of fresh and iced codling muscle

Two-dimensional chromatograms of chloroform-separated, aqueous ethanol extractives prepared from freshly killed codling showed a large ninhydrin-reacting spot; R_F: phenol–ammonia, 0·40; collidine–lutidine, 0·41 (Fig. 2). The spot, larger than that of other ninhydrin-reacting substances, was not attributable to any basic extractive found by Shewan[1] and Shewan *et al.*[3] in sulphonated-polystyrene column separations of codling or haddock extracts.

Examination of effluents from aqueous ethanol-equilibrated 4½%-cross-linked sulphonated-polystyrene resin (H^+-form) columns on the passage of ethanolic codling extracts showed that the unidentified substance had not exchanged with resin hydrogen ion (Fig. 3). This accounted for its absence in the separations of the earlier workers, who had not investigated initial effluent constituents. Failure to exchange with resin hydrogen ion also indicated a likely acidic nature.

R_F values of the compound in phenol–ammonia and collidine–lutidine and also that in butanol–acetic acid (0·29) coincided with those of taurine (β-aminoethylsulphonic acid). That the compound had amino-nitrogen in a position other than α to the acidic grouping was indicated by its behaviour on chromatograms treated with $CuCO_3,Cu(OH)_2$,[9] on which the running of α-amino-compounds is retarded by complexing with copper. Fig. 4 shows that the running of the spot was not affected. This was additional evidence of the probable identity of the compound.

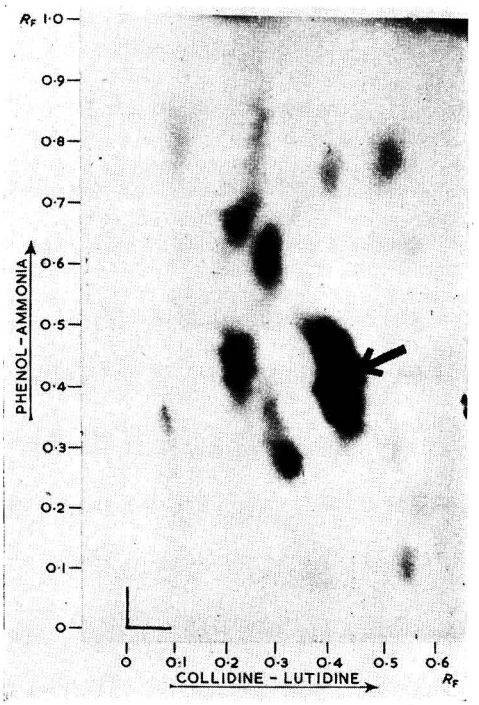

FIG. 2.—*Two-dimensional chromatogram of codling extractives; arrow indicates unidentified spot*

Isolation of taurine from codling muscle

Taurine was isolated by two methods:

(*a*) Fresh codling muscle (2 kg.) was minced and the pH adjusted to 4 by addition of 5N-hydrochloric acid. The mince was mixed into 20 l. of boiling distilled water and the temperature maintained at 100° for 15 minutes. The resulting slurry was clarified successively through muslin, a Sharples supercentrifuge at 24,000 r.p.m. and finally paper pulp. Clear extract was then run through a column of H^+-form 4½%-cross-linked sulphonated-polystyrene

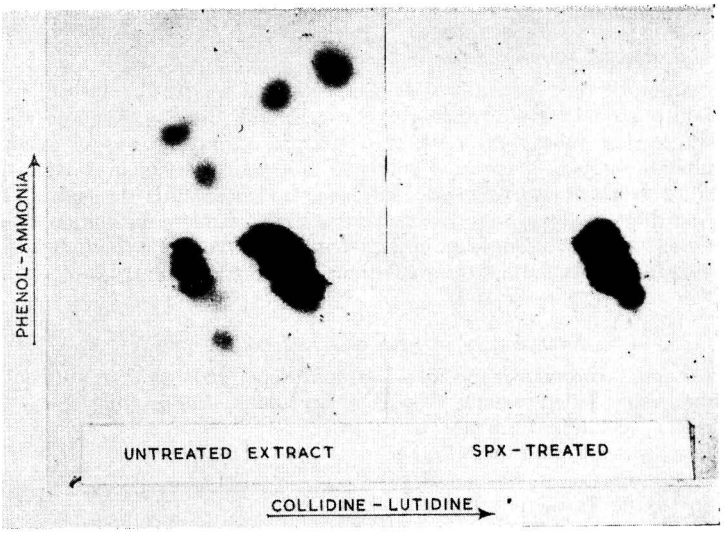

FIG. 3.—*Two-dimensional chromatograms of codling extractives before and after exchanging with 4½%-cross-linked sulphonated-polystyrene resin (SPX)*

resin, dimensions 5·5 cm. × 45 cm., particle size 60–100 mesh. The column was washed with distilled water until the effluent gave no reaction with ninhydrin, and combined initial effluent and washings were evaporated under reduced pressure to 1 l. Chromatography showed a strong presumed taurine spot and traces of two other ninhydrin-reacting substances.

Taurine was isolated from this concentrate by a method based essentially on the later stages of that of Campbell & Work[10] for mammalian liver. This involved successive fractionation with mercuric acetate,[11] phosphotungstic acid[12] and De-Acidite E anion-exchange and Dowex-50 cation-exchange resins. By recrystallizing the product twice from aqueous ethanol,

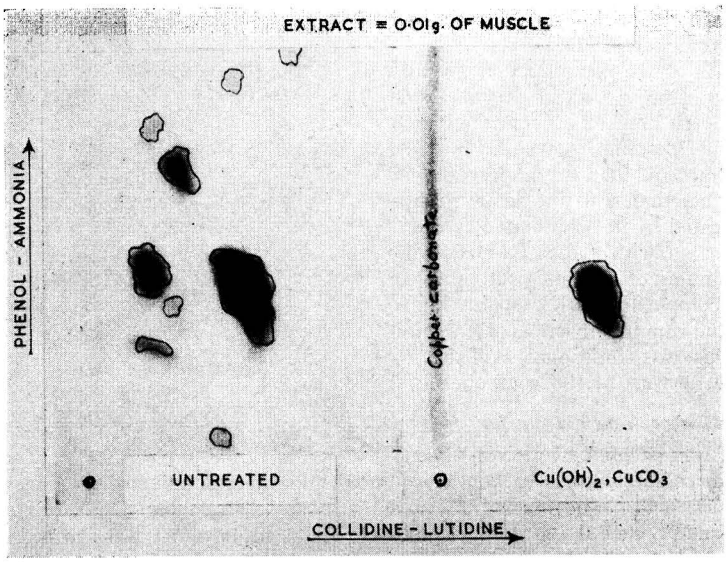

FIG. 4.—*Two-dimensional chromatograms of codling extractives; effect of treatment with* $Cu(OH)_2,CuCO_3$

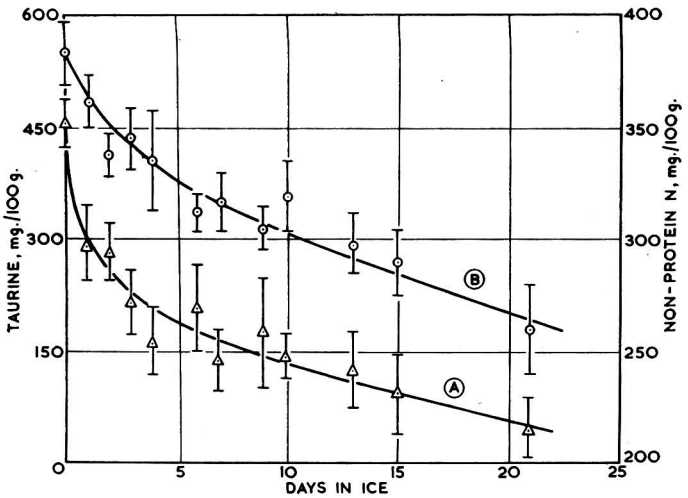

FIG. 5.—*Taurine (curve* A) *and total extractable nitrogen (curve* B) *in codling muscle after different storage periods in ice (June)*

1·2 g. of white crystals was obtained (Found: N, 11·1%. Calc. for taurine: 11·2%). The melting point alone and mixed with an authentic sample of taurine was 328° (uncorr.). A positive reaction for sulphur with nitroprusside was obtained.

(*b*) Codling muscle (2 kg.) was minced into 6·4 l. of ethanol and warmed to 60° for 5 minutes. The suspension was filtered and the tissue re-extracted with hot 80% (v/v) ethanol. The combined extracts were cooled and passed through an ethanol-equilibrated H^+-form $4\frac{1}{2}$%-cross-linked sulphonated-polystyrene resin column, dimensions 5·5 cm. × 48 cm., 60–100 mesh. Ethanol (80%) was then passed through the column until the effluent gave no spot with ninhydrin. The combined effluent and washings were then concentrated to 1 l. under reduced pressure and 3 l. of chloroform was added, with vigorous shaking. The resulting emulsion was separated by centrifuging at 3000 r.p.m. and the upper, aqueous layer freed from chloroform with a stream of nitrogen. It was then separated through three Dowex-2 (OH^--form) anion-exchange resin columns in series; dimensions (i) 2·8 cm. × 20 cm., 200 mesh; (ii) 1·6 cm. × 10 cm., 300–400 mesh; (iii) 1·2 cm. × 8 cm., 300–400 mesh. Exchanged anions were displaced with 0·075N-hydrochloric acid. A single ninhydrin-reacting substance was displaced in the earliest fractions. These were concentrated to dryness *in vacuo* and the white residue was triturated with dry ether to remove traces of contaminating organic acid. Recrystallization from aqueous ethanol gave 1·4 g. of taurine, m.p. 328°; N, 11·2%. Campbell & Work[10] were unable to carry out such separations on De-Acidite F, but their liver extracts contained relatively large amounts of glycerylphosphorylethanolamine and phosphorylethanolamine. This latter compound appeared to be one of the trace substances present in the initial column effluent.

Taurine in fresh and iced muscle

By using the spot-elution technique with two-dimensional chromatograms it has been found that fresh codling within a batch have relatively constant muscle taurine-levels. Considerable variations have been found between batches. These differences appear to derive from the effects of seasonal and nutritional variation and are the subject of continued long-term studies, which are beyond the scope of the present paper.

Figs. 5–8 illustrate the effect of storage in ice on muscle taurine-levels in gutted codling of different batches. Vertical lines represent the scatter (S.D. $= \sqrt{[\Sigma d^2/(n-1)]}$) about arithmetic means of groups of 5–6 fish within a batch. Fig. 5 also illustrates changes in total non-protein N-levels under these conditions. A constant room temperature of 2·5° was maintained throughout the experiments, and the results relate only to these standard conditions.

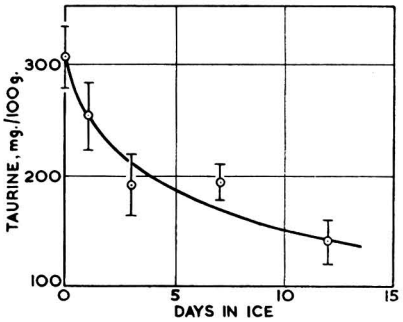

FIG. 6.—*Taurine in iced codling muscle (April)*

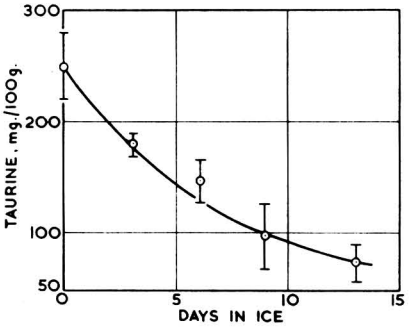

FIG. 7.—*Taurine in iced codling muscle (September–October)*

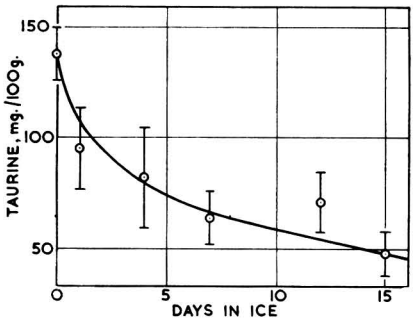

FIG. 8.—*Taurine in iced codling muscle (December)*

Figs. 5–8 show that taurine was lost continuously through a storage period in ice, with the greatest rate of loss during the first five days. Concomitant losses in total extractable nitrogen were also found, although of a lower order of magnitude.

Taurine in muscle macerates at 0°

Muscle (10 g.) was macerated into 250 ml. of ice-cold distilled water under sterile conditions and inoculated with 1 ml. of a suspension of codling-skin macerate in sterile distilled water as a source of marine spoilage micro-organisms. The muscle-skin suspension was incubated at 0° and a stream of sterile air drawn through to maintain aerobic conditions. Samples for taurine analysis were withdrawn periodically. Fig. 9 illustrates the lack of change in taurine level (Curve A) during such an incubation period of seven days. During this time a heavy, typical, marine spoilage microflora developed and considerable changes in the overall free amino-acid ' picture ' occurred.

Taurine in washed muscle blocks at 0°

Blocks of muscle (1·0 ± 0·04 g.) from the same fillet were individually suspended in 50 ml. of sterile water containing 2 drops of chloroform and 2 drops of toluene. The temperature was maintained at 0°. Periodically, pairs of blocks were withdrawn and lightly blotted. Moisture determination was carried out on one block and taurine on the other. Fig. 9 illustrates the rapid loss of taurine under these conditions (Curve B).

Discussion

The isolation, identification and estimation of taurine in codling muscle have established it as a major extractive in this economically important species, comparing in level with trimethylamine oxide[13] at 220–390 mg. and creatine[14, 15] at 300–370 mg. per 100 g. of muscle. Taurine has been reported in the liver and bile of other fish species,[16–19] in herring (*Clupea harengus*) extractives,[20] and in dried Japanese cod (*Gadus*

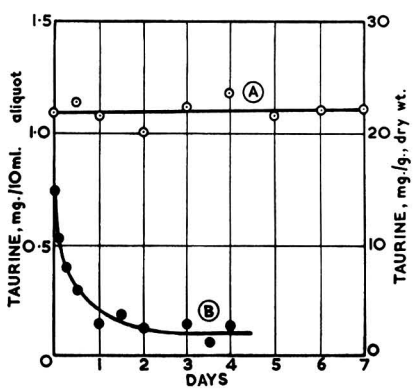

FIG. 9.—*Taurine in muscle-skin macerate during incubation* (A) *and leached muscle* (B) *at* 0°

brandtii).[21] In this last material, the substance could readily be produced by processing changes *post mortem* from cysteine and its derivatives through cystine and cysteic acid.

It is now well established that changes in the muscle extractives produced by bacterial action during storage in ice are of very great importance in relation to palatability.[22] Recent work has demonstrated that the action of autolytic-type enzymes (such as anserinase[23] which cleaves the dipeptide anserine to its constituent L-methylhistidine and β-alanine) also plays a considerable part in changes in the nitrogenous extractives during the earliest stages of spoilage.

The present paper indicates that a combination of seepage or 'drip' from the muscle of gutted codling and the leaching action of melt water leads to losses of taurine. Although lowered taurine levels were found in fish iced under trade conditions or exposed to the leaching action of ice-cold water under sterile conditions, no comparable changes occurred under conditions precluding such losses but which would allow autolytic or bacterial action. Such leaching losses in iced fish have been detected among flavouring and other constituents by other workers.[24–26] Tarr[27] demonstrated a removal of 'browning' reaction components from fish muscle by leaching with cold running water.

Unlike many other nitrogenous extractives, taurine appears to be particularly resistant to attack by marine spoilage micro-organisms, at least in the early storage stages. As it cannot readily derive from proteolytic actions, it may well be a useful marker compound for further studies on amino-acid migration in iced muscle. In this relation various postulates (e.g. Kurtz & Luck[28]) that taurine has an osmoregulatory function in marine and other species have yet to be verified experimentally.

Acknowledgments

Mr. W. Hodgkiss carried out the bacteriological examination of samples. The work described in this paper was carried out as part of the programme of the Food Investigation Organization of the Department of Scientific and Industrial Research. All illustrations are Crown copyright.

Department of Scientific and Industrial Research
Torry Research Station
Aberdeen

Received 28 June, 1954

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STABILITY OF CAROTENE FROM DRIED GRASS MEAL AND OF SYNTHETIC VITAMIN D_3 IN CHICK MASH

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Two experiments were carried out to determine whether 5% of dried grass meal as a source of carotene, together with 1 i.u./g. of synthetic vitamin D_3 (cholecalciferol), can satisfactorily replace cod-liver oil in providing vitamins A and D_3 in chick mashes, and to assess the stability of these vitamins in normal commercial storage for up to 16 weeks. The rate of loss of carotene varied for different mashes and averaged 1% per week; grass meal stored alone lost only 0·5% of its carotene per week. The vitamin-D supplement proved ample at the end of the storage period, and with dried grass of good quality satisfactorily supplied the needs of chicks.

Introduction

Evidence on the stability of vitamin A added as fish-liver oils to chick mashes is conflicting. Fraps & Kemmerer[1] found that 79–100% of vitamin A from cod-liver oils added to white maize meal was destroyed after 4 weeks' storage. Kon & Thompson,[2] Morton *et al.*[3] and Halverson & Hart[4] showed that in general the vitamin A of cod-liver oil was reasonably stable over the period that would normally elapse between mixing and consumption.

Many workers have turned to carotene as a source of vitamin A in mixed feeds. Kamstra *et al.*[5] found that carotene in lucerne was better preserved than in carrot oil when mixed with poultry feeds. Mitchell & Silker[6] found that 41% of the carotene was lost in 16 weeks when added as lucerne to a broiler mash. Dammers[7] surveyed the earlier literature and concluded that vitamin A is less stable than carotene. He reported losses of carotene from mixed feeds at the rate of 1% per week during the winter and 3% per week during the summer. More recently Davies & Worden[8] found that, in a mixed feeding-stuff, vitamin A was destroyed faster than carotene. Davies & Worden have listed 33 references to 'those whose work has a bearing on the problem'.

The experiments to be described were designed to study the stability of carotene in a chick mash made with dried grass meal plus synthetic vitamin D_3 (cholecalciferol) (in powder form) instead of cod-liver oil, and stored under commercial conditions.

Experimental methods

Compounding, storage and sampling

Experiments were done in two consecutive years to investigate the stability of carotene in dried grass§ meal alone or mixed into a chick mash, each experiment covering the normal times for the commercial production and storage of these mashes, that is November to February. In the first year (Experiment 1) seven compounders collaborated and only chemical tests were done. Each compounder made a batch of one ton of chick mash to his own recipe but with approximately 5% of dried grass and 1 i.u./g. of vitamin-D_3 powder replacing the cod-liver oil normally used. At the mixing machine, 13 small bags and 12 1-cwt. sacks were filled alternately. The small bags were used to estimate the initial level of carotene and to assess variations during the mixing. Samples from three compounders were analysed at Shinfield and four at Cambridge. Each compounder sent the 13 bags for analysis immediately after mixing and the contents of each bag were analysed in triplicate. The 12 1-cwt. sacks were stored by the compounder under normal commercial conditions. After each of 1, 2, 4, 8 and 16 weeks of storage 2 sacks were withdrawn. The contents of each sack were mixed separately and from each about a kg. was taken for analysis. The carotene was estimated in triplicate in this sample. The undiluted grass meal was similarly stored, and sacks of it were withdrawn

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§ Dried green-crop meal; the term 'grass' is, by common consent, used even when the meal is made from lucerne.

and sampled after 1, 4 and 16 weeks' storage. The 16-week storage was longer than is normal in practice for mashes.

In the second year (Experiment 2) one compounder (No. 8) provided a similar mash which was tested both chemically and biologically. This mash was mixed in a screw-type batch-mixer for two hours. The storage and sampling were as in the previous year's experiment. One sackful was run off before the dried grass and vitamin D were added, to be used later as unfortified mash ' in the biological test.

Carotene estimation

Mashes and meals were extracted at 90° with light petroleum[9, 10] (b.p. 80–100°). Mashes only were also given a short second extraction. The carotene was separated chromatographically on aluminium oxide mixed with sodium sulphate[11] and estimated absorptiometrically.

Moisture estimations

These were made on some samples by oven drying.

Biological test

This test was designed to assess the antirachitic and vitamin-A activity of the chick mash after 16 weeks' storage. Six groups of 15 R.I.R. × L.S. cockerels were used. One group was given the unfortified mash, three other groups received mashes in which 25, 50 and 75% of the unfortified mash was replaced by the fortified mash, another group was given the fortified mash only and the last group the fortified mash plus 1% of cod-liver oil. The chicks were given the diets from the day of hatching until 27 days of age. The mash was 16 weeks old at half-way through the test. At the end of the experiment the left hock joints were radiographed and the tarso-metatarsal distances (T.M.T.) were measured to estimate the extent of rickets.[12] The birds were then killed and the vitamin-A contents of the livers were estimated chemically.[13]

Results

Chemical tests

The moisture contents of both the chick mash and grass meal were normal (11%) and fairly constant. The carotene values have therefore been computed on the air-dry basis.

As the meals used contained high proportions of maize products, it was necessary to determine how much of the active carotenes of maize pigments would be extracted and estimated with the carotenes of the grass meal. The following products were examined in this way: a sample of maize; a mash deficient in vitamin A; the same mash after addition of 5% of dried grass meal; and a complete mash consisting of 75% of deficient mash, 5% of dried grass meal and 20% of maize. The presence of maize increased the carotene content of the diet containing the dried grass by 2·5%. The carotene values reported include the contributions both from maize and from grass meal. The method used did not estimate cryptoxanthol, of which the mash contained 2 p.p.m.

The values for the 13 small bags from each compounder were examined for any changes during the mixing run. The figures in Table I give the average increase or decrease in carotene

Table I

Regression coefficients of carotene content (p.p.m.) on bag number in the mixing run

	Compounder	
Expt. 1	1	0·51 ± 0·078
	2	− 0·06 ± 0·024
	3	0·03 ± 0·050
	4	0·38 ± 0·126
	5	0·02 ± 0·070
	6	0·12 ± 0·023
	7	− 0·01 ± 0·027

It was obvious by inspection that there was no trend in the carotene content during the mixing run of Expt. 2 (compounder 8), and comparison of the dispersion of the eight means of successive small bags with the average dispersion within a small bag showed that mixing was adequate.

Table II

The loss of carotene from chick mash and grass meal after 16 weeks' storage

Compounder		Carotene content of chick mash			Carotene content of grass meal		
		Initial	At 16 weeks		Initial	At 16 weeks	
		p.p.m.	p.p.m.	Percentage of initial	p.p.m.	p.p.m.	Percentage of initial
Expt. 1	1	7·2	6·6	92	120	113	94
	2	5·2	3·8	73	94	90	96
	3	8·3	7·4	89	162	134	83
	4	17·4	14·6	84	377	373	99
	5	13·4	11·4	85	253	223	88
	6	6·7	5·8	87	97	75	77
	7	3·6	3·4	94	93	101	109
Expt. 2	8	19·6	17·3	88	369	337	91
			Mean	86·5		Mean	92·0

content from one sample to the next. They show slight trends in some instances, e.g. that the mashes from compounders 1 and 4 were unevenly mixed. This unevenness would have had the effect of making the final results irregular through individual sacks having different starting values. Because of this the mean value for the two small bags taken immediately before and after a sack was filled was accepted as the initial value for this sack. In the second experiment when a batch mixer was used the variation was reduced considerably. Fig. 1 shows mean retentions of carotene expressed as percentages of the initial values for each test, and Table II gives the values for each compounder initially and after 16 weeks' storage. There were substantial differences both in the initial value and in the rate of loss of carotene in chick mashes from different compounders, though the rate of loss was not related to the initial value. The smallest loss recorded at 16 weeks was 6% for compounder 7 and the largest was 27% for compounder 2. The average loss after 16 weeks was relatively small, equivalent to about 1% of the initial value per week.

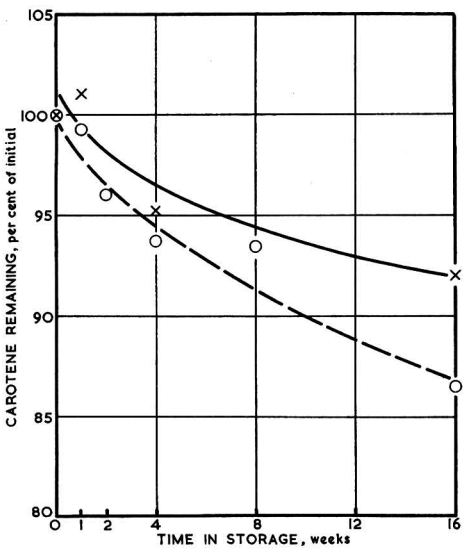

FIG. 1.—*Retention of carotene in chick mash and dried grass meal expressed as percentage of the initial value*

O— — —O Chick mash X——X Dried grass meal

Differences in the initial carotene contents of the various grass meals were large. The lowest value was for compounder 6, at 97 p.p.m., and the highest 377 p.p.m. for compounder 4. The average loss for grass meal stored alone was at about half the rate found for the chick mash. The highest loss over 16 weeks was 23%. No explanation can be put forward at present for the increase in carotene content observed in the grass meal for compounder 7. The difference may be real for it is not considered to be due to the analytical technique.

Biological test

This test was carried out in the second year on one mash only (Experiment 2). Table II shows that the dried grass meal used was of high quality (carotene content 369 p.p.m.) ; owing to the use of a batch mixer for 2 hours the mixing was good (Table I). The mean body weights, T.M.T. measurements and vitamin-A reserves in the livers of each group of chicks are given in Table III.

Table III

Results of the biological tests on chick mashes for the stability of vitamins A and D_3

Diet	Final body wt., g.	T.M.T., mm.	Vitamin A, i.u./liver	
			Alcohol	Ester
	Means of individual measurements		Values on pooled samples	
Unfortified mash	184	1·633	2·9	7·2
3 parts of unfortified mash, 1 part of fortified mash	213	1·092	5·8	93
2 parts of unfortified mash, 2 parts of fortified mash	183	1·108	8·9	220
1 part of unfortified mash, 3 parts of fortified mash	200	1·217	10·4	290
Fortified mash	210	1·170	12·5	496
Fortified mash + 1% of cod-liver oil	197	1·233	16·6	840

Vitamin D_3

Analysis of variance showed that the difference between the mean T.M.T. measurement for birds given the unfortified mash and the measurements for birds given the remaining treatments was very highly significant ($P < 0.001$). As it had not been possible to replicate the groups the difference may be partly the result of uncontrolled variation from cage to cage. Otherwise the difference can be taken as indicating that, although the unfortified mash was deficient in vitamin D_3, the amount added to the fortified mash (1 i.u./g.) was more than ample, as an admixture of only 25% of the fortified diet with the unfortified mash resulted in normal bone formation.

Vitamin A

The differences in body weight between the groups were just significant ($P = 0.05$), but the results were inconclusive as the highest mean weight was reached by the group given only 25% of the fortified diet. It is possible that these differences were also partly due to variations from cage to cage. However, all birds grew poorly and even the heaviest group weighed about 50 g. less than birds from the same hatch on a normal diet. It is unlikely that these low weights resulted from a deficiency of either vitamin A or D_3, as the addition of 1% of cod-liver oil did not improve them. It is possible that some basic constituent of the diet, probably protein, was inadequate and that if the chicks were given a better basal ration and were therefore able to grow faster their requirements of vitamins A and D might not have been so amply covered by the mash.

The unfortified mash contained sufficient vitamin-A precursors to promote growth and a slight storage of vitamin A in the liver. This mash contained 0·4 p.p.m. of carotene and 2·2 p.p.m. of cryptoxanthol. Together they corresponded to a biological activity of not more than 1·5 p.p.m. of carotene.

Conclusion

It is concluded that the stability of carotene and vitamin D_3 is satisfactory in chick mash which contains dried green-crop meal and synthetic vitamin D_3.

Acknowledgments

The authors are indebted to Dr. S. K. Kon for his interest and guidance at all stages of this work, and to Mr. F. J. Anscombe and Mr. M. D. East for part of the statistical analysis.

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Received 19 July, 1954

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THE PRESERVATION OF SEAWEED BY ENSILING AND BACTERICIDES

By W. A. P. BLACK

Marine algae decompose much more rapidly than land plants and various attempts have been made from time to time to preserve them. This paper mainly summarizes preliminary work carried out on ensiling from the point of view of preserving the algae for use as a possible feeding-stuff for farm animals and also for chemical processing.

Introduction

Considerable work has been carried out on the conservation of grass and forage crops and it has been found that, in order to effect their preservation with the minimum change in chemical constitution, it is essential to check respiration as soon as possible and to prevent subsequent fermentation. In many ensiling processes for land crops the carbon dioxide liberated by respiration is used to control the fermentation, and salt, sulphur dioxide, carbon disulphide, formaldehyde, formic acid, phenol, borax, benzoic acid and salicylic acid[1] have also been tried. The most practical system was ensiling, and the use of acid to lower the pH [A.I.V. (A.I. Virtanen) process] has resulted in less loss than the normal method of bacterial fermentation.

The bacterial decomposition of marine algae is a problem that has received little attention in the past, but it is at present being investigated at the Universities of Edinburgh and Nottingham. Bacteria that actively decompose several of the constituents of algae have been isolated from sea-water, from piles of decomposing weed and from different types of soil. Decomposition may take place, therefore, through the agency of organisms living in the sea or on the shore, or by infection picked up from purely terrestrial sources, or by a mixture of both.

In America, fresh *Laminaria digitata* is preserved, for later processing, by storing it in large 'curing tanks' containing sea-water with added sodium chloride and formalin, and in Britain a patent[2] was taken out in 1937 for the preservation of algae by impregnating with sulphur dioxide gas. No attempt is made in any country, with the exception of America, to preserve fresh algae on a large scale, the normal procedure being to dry and store as dried material.

Experimental and discussion of results

The methods for the determination of water, total ash, laminarin, mannitol, cellulose, alginic acid, L-fucose, Kjeldahl and total nitrogen were those previously used by the writer; [3–6] the water content was also determined by the Tate & Warren method[7] and the free sugars by the method of Shaffer & Somogyi.[8] The water-soluble or non-protein-nitrogen content (N.P.N.) was obtained by extracting the fresh alga (20 g.) with distilled water (150 ml.) under

boiling reflux for 30 min., filtering through filter cloth, washing the residue with hot water so that the washings and filtrate totalled 250 ml., and carrying out an estimation, as for Kjeldahl nitrogen, on 100 ml. of this solution. The N.P.N. content of the dried milled weed was determined by extracting 2 g. with 3 × 50 ml. of boiling water, refluxing in each case for 10 min. and washing the residue with 30 ml. of water. The aqueous extracts were combined, the volume was made up to 250 ml. and a Kjeldahl nitrogen estimation carried out on a 100-ml. sample. The volatile fatty acids were determined by the method of Wiegner.[9]

Effect of subdivision on the rate of decomposition

Initial experiments were carried out to determine the effect of subdivision on the rate of decomposition. The alga was either chopped into pieces or minced in a butcher's mincer. It was found that the rate of decomposition was greatly accelerated by finely dividing the weed, which produced copious exudation of mucilage.

Preservation by chemical means

Experiments were carried out with complete *Fucus serratus* plants (6–9 in. in length) immersed in sea-water containing preservatives such as potassium metabisulphite, trichlorophenol, sodium *o*-phenylphenoxide, pentachlorophenol etc. The concentration of preservative, however, required to effect preservation killed the plant, resulting in complete loss of the soluble constituents into the surrounding medium. ' Pickling ' in solutions of sea-water with at least 20% of added sodium chloride was also quite effective, but also considerably altered the composition in regard to the water-soluble constituents. Preservation in liquid media, however, involves such large volumes of liquid as practically to rule out this method as a possible means of preservation on a large scale. The spraying of the fresh algae with a solution of the preservative was not attempted because of the difficulty of ensuring, on a large scale, that the preservative permeated the entire mass. The only gaseous sterilizing agent which was tried was sulphur dioxide and this is referred to below.

Preservation by ensiling

Initial experiments were carried out on 31 October, 1951, with freshly harvested *Laminaria cloustoni* frond, *Ascophyllum nodosum* and grass. The material was finely minced and 50-g. samples were packed into 1-in.-diameter test-tubes fitted with mercury air traps and incubated at 30°, air being excluded. The results are summarized in Table I, and from these it can be concluded that *L. cloustoni* supported a more vigorous acid fermentation than the grass when made into silage. Mixtures of 80% of grass and 20% of seaweed did not reach a pH of 4·4 in seven days, which is required for satisfactory preservation; this was also found with the grass alone, which, however, appeared to have been low in sugars and unsuitable for ensiling. The bacterial counts and the other tests carried out indicated that the organisms occurring on the fresh algae, and more especially those that formed acid in the ensiled weed, were different from those found on grass and in grass silage. That, together with differences in fermentable carbohydrates, perhaps explains why the addition to grass of a relatively large amount of seaweed did not promote a more active acid formation. The bacterial plate count for *A. nodosum* showed little increase on ensiling, but that for *L. cloustoni* increased from 0·019 to 1,660 millions/g. of dry matter, which is no doubt due to the higher percentage of fermentable carbohydrates in *L. cloustoni*.

Ether extracts of aqueous homogenates were also examined on paper chromatograms with the following results:

	Lactic acid	Succinic acid	Acetic acid	Propionic acid	Butyric acid
L. cloustoni (pH 4·21)	+++	+	+++	o	+++
A. nodosum (pH 4·77)	++	+	+	+	o

After 5 weeks' incubation at 30°: Heavy spot +++ Medium spot ++ Light spot +

(1) *Laboratory-scale experiments under aerobic conditions*

Fresh *L. cloustoni* frond was minced through a $\frac{1}{4}$-in. plate and samples were packed tightly

Table I

Laboratory ensilage of grass, L. cloustoni *and* A. nodosum

	pH	Bacterial plate count, millions/g. of dry matter (D.M.)
Fresh materials		
Grass (26·5% D.M.)		60·6
Laminaria cloustoni (30·1% D.M.)	6·03	0·019
Ascophyllum nodosum (26·0% D.M.)	6·24	0·020
Ensiled 2 days at 30°		
Grass	6·23	794
L. cloustoni	6·42	151
A. nodosum	5·78	0·063
Grass + *L. cloustoni* (4 : 1)	5·76	—
Grass + *A. nodosum* (4 : 1)	5·97	—
Ensiled 3 days at 30°		
Grass	5·88	—
L. cloustoni	5·80	—
A. nodosum	5·46	—
Grass + *L. cloustoni*	5·14	—
Grass + *A. nodosum*	5·59	—
Ensiled 7 days at 30°		
Grass	5·58	191
L. cloustoni	4·20	1660
A. nodosum	4·84	0·037
Grass + *L. cloustoni*	4·84	676
Grass + *A. nodosum*	5·34	324

into 500-ml. bottles closed with ordinary parchment-paper covers, and the bottles kept under observation at 5–10°. Bottles were opened at intervals and the contents analysed. The results are given in Table II. Under aerobic conditions fairly rapid decomposition occurred, resulting in a loss of mannitol and alginic acid and a marked increase in the Kjeldahl nitrogen; laminarin appeared to be unaffected. After 80 days no mannitol or alginic acid remained. This, however, may not mean the complete breakdown of the alginic acid molecule, but only partial degradation to a molecule not precipitated by calcium chloride, and not estimated by the standard method. On the other hand, bacteria have been shown to be present in sea-water, decomposing weed and in soil which can utilize alginic acid as their sole source of carbon.[10] Recently, an alginase has been isolated from soil bacteria which hydrolyses alginic acid to mannuronic acid.[11]

Table II

Preservation of L. cloustoni *frond under aerobic conditions at* 5–10°

	Dry matter, %	Composition, % (dry basis)					
		Total ash	Laminarin	Mannitol	Kjeldahl nitrogen	Crude proteins	Alginic acid
Original sample (12/12/51)	15·1	28·0	9·2	11·0	1·91	11·9	16·7
After 22 days	17·4	31·9	8·7	4·9	2·80	17·5	5·9
,, 64 ,,	10·2	42·2	13·9	1·6	3·15	19·7	1·9
,, 80 ,,	11·6	43·0	13·0	nil	3·30	20·6	nil

(2) *Laboratory-scale experiments under anaerobic conditions*

(*a*) Fresh *L. cloustoni* frond (collected Inchcolm 12/2/52) was minced ($\frac{1}{4}$-in. plate) and packed into 500-ml. glass bottles fitted with stoppers carrying mercury seals. The bottles were maintained at temperatures of 15° and 30° under anaerobic conditions and examined at intervals. The results are given in Table III. With the material that had been treated with sulphur dioxide gas (Sample 5, Table III), no significant change in composition was evident after 50 days, the small amount of exuded cell sap at the bottom of the bottle being sufficient to account for the differences obtained. With the other samples, however, although no change occurred in the amount of dry matter, the composition had altered appreciably. The most significant change was in the content of Kjeldahl nitrogen, ' crude proteins ' appearing to be synthesized at the expense of the carbohydrates, mannitol and laminarin, as long as there

Table III

Preservation of L. cloustoni *frond under anaerobic conditions at* 15° *and* 30°

Sample	Dry matter, %	Composition, % (dry basis)									
		Total ash	Mannitol	Laminarin	Kjeldahl nitrogen (K.N.)	Non-protein-nitrogen (N.P.N.)	Protein-nitrogen (K.N. −N.P.N.)	Crude proteins (K.N. ×6·25)	Total nitrogen	Inorganic nitrogen	Alginic acid
(1) Initial sample (12/2/52) pH 7·2	17·7	31·5	9·4	6·0	2·46	1·93	0·53	15·4	3·54	1·08	14·7
(2) After 14 days at 15°	16·1	33·8	2·8	2·8	2·75	—	—	17·2	—	—	14·1
(3) After 14 days at 30° pH 6·4	16·0	34·9	1·2	1·8	3·16	2·06	1·10	19·8	3·60	0·44	13·0
(4) After 50 days at 30° pH 6·0	17·1	32·8	nil	1·2	3·24	—	—	20·3	3·56	0·32	13·2
(5) After 50 days at 30° SO_2-treated	19·2	30·9	5·3	6·4	2·60	—	—	16·3	—	—	13·5

was a supply of inorganic nitrogen. Macpherson[12] has found the determination of protein by precipitation as a copper complex to be unreliable and has found it better to extract the non-protein-nitrogen and estimate protein-nitrogen by difference. When the N.P.N., therefore, was determined for the initial sample and the sample after three days the increase was insignificant, whereas the protein-nitrogen increased from 0·53 to 1·10%, indicating that the increase in Kjeldahl nitrogen was due to true protein.

The results agree with those obtained from experiments carried out to determine the changes in composition likely to occur in the time which elapses between the harvesting of the weed and its utilization. Freshly harvested *L. digitata* plants (20) were selected at random and within 20 minutes of harvesting were treated in the following way: 2 were dried immediately, 6 were placed in a 40-gal. stainless-steel drum containing sea-water, 6 in another drum containing sea-water plus formalin (1 part in 500 parts of sea-water) and the remaining 6 were wrapped in cotton wool saturated with sea-water. The drums were covered with heavy tarpaulins to exclude light, and plants were removed at intervals, dried and analysed. With the plants in the sea-water containing the formalin, death occurred instantaneously, resulting in immediate diffusion of the mannitol and the laminarin into the surrounding sea-water. With the plants in the sea-water alone and in the cotton wool, the results were so similar that only those for the sea-water are given in Fig. 1. These results show that, in the dark, 'proteins' are synthesized at the expense of mannitol when inorganic nitrogen is available. Up to the first day, inorganic nitrogen (0·22% of dry matter) was present in the fronds, but was not detectable afterwards. During the first 24 hours the mannitol content decreased from 22·7 to 14·3%, and the crude proteins increased from 8·1 to 13·0%. The crude protein content then decreased from 13·0 to 8·8%, and the mannitol increased to 21%. At the same time the laminarin decreased from 7·7 to 1·5% and the increase in mannitol may have resulted from the breakdown of laminarin in respiration, or from the breakdown of a 'mannitol–amino-acid complex' synthesized during the first 24 hours when nitrate was available. The main differences between the plants at the beginning and the end of the test were the disappearance of inorganic nitrogen and laminarin. The results of these experiments are given as further evidence that 'protein' synthesis is possible during ensiling.

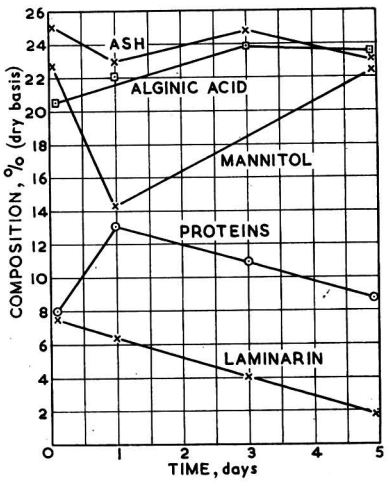

FIG. 1.—*Change in composition of* L. digitata *fronds (June* 1947), *in sea-water*

(*b*) In another series of experiments *L. cloustoni* plants collected at Inchcolm on 27 February, 1952, were separated into fronds and stipes which were minced separately through a ¼-in. plate. Samples of each were packed tightly into sterilized test-tubes (8 in. × 1½ in.), fitted with rubber bungs and mercury seals, and the tubes were maintained at 30° under anaerobic conditions. The results summarized in Table IV indicate that, with the fronds, as in the previous experiment, when inorganic nitrogen was available (1·2% of the dry matter), true proteins were synthesized whereas mannitol was utilized, the protein-nitrogen increasing from 1·43 to 2·16%. With the stipes, however, where no inorganic nitrogen was present (Kjeldahl nitrogen 1·89, total nitrogen 1·90%), no significant change in composition occurred after 72 days. Under anaerobic conditions it is interesting to note that no apparent change occurred in the alginic acid, in contrast with the breakdown which occurred under aerobic conditions.

Table IV

Preservation experiments with L. cloustoni *frond and stipe* (27/2/52) *at* 30° *under anaerobic conditions*

Frond

	Dry matter, %	Composition, % (dry basis)							
		Total ash	Mannitol	Laminarin	Kjeldahl nitrogen	N.P.N.	Protein-nitrogen	Crude proteins	Alginic acid
Initial sample	14·7	37·3	5·0	nil	2·62	1·19	1·43	16·4	15·8
After 14 days	12·5	39·5	1·1	nil	3·60	1·44	2·16	22·5	16·0
,, 72 ,,	14·4	43·1	nil	nil	4·00	—	—	25·0	16·2

Stipe

	Dry matter, %	Composition, % (dry basis)				
		Total ash	Mannitol	Laminarin	Crude proteins	Alginic acid
Initial sample	15·4	38·8	6·2	nil	11·7	19·3
After 14 days	15·9	37·0	4·5	nil	11·8	19·4
,, 72 ,,	14·0	37·8	4·0	nil	11·5	19·2

(*c*) *L. digitata*, *L. cloustoni* and *L. saccharina* fronds collected at Inchcolm on 16 June, 1952, were minced through a ¼-in. plate and samples packed into six sterilized test-tubes (8 in. × 1½ in.), fitted with rubber stoppers and mercury seals. The tubes were incubated at 30°, two were removed at intervals of 24, 48 and 72 hours, and the contents dried and analysed. The analytical results are given in Table V; they agree with those previously obtained. Only where there was inorganic nitrogen present in any quantity was there any major change in chemical composition. With *L. saccharina* low in inorganic nitrogen, no significant change in composition occurred. In contrast, *L. digitata* contained a reserve of inorganic nitrogen and the mannitol was almost completely utilized, and there was an increase in the crude protein content from 11·5 to 14%. *L. cloustoni* was intermediate between *L. digitata* and *L. saccharina*, the mannitol content decreasing from 9·1 to 5·1% and the crude protein increasing from 11·5 to 13% (dry basis). In all cases, the seaweed constituents exerted a buffering action and prevented the pH from falling below 4·7.

Pilot-scale experiments

The experiments were carried out in concrete pipes, coated internally with bitumen paint (Fig. 2), which held approximately 6 cwt. of chopped weed. Except with *L. cloustoni*, when two days elapsed between harvesting and ensiling, the algae, the same day as harvested, were put through a Robust Cutter, giving pieces 1 in. and less, and packed tightly into the pipes until 1 ft. from the top. This was covered with bitumen paper, and soil was added to the last foot of pipe and pressed firmly down. A metal cover was then put over the top to exclude rain. Samples of liquor were withdrawn at intervals from the run-off pipe. Samples of the algae were also packed into 500-ml. glass bottles fitted with stoppers and mercury seals and incubated at 30°.

(1) A. nodosum *collected at South Queensferry* 4/7/52.—The results of this experiment are summarized in Table VI. As a check on the oven-drying method, the water in the fresh samples after ensiling was also estimated by the Tate & Warren method;[7] both methods gave almost

Table V

Preservation experiments with L. digitata, L. cloustoni *and* L. saccharina *fronds collected Inchcolm 16/6/52 and incubated at 30°; laminarin was absent from all samples*

	L. digitata frond	*L. cloustoni* frond	*L. saccharina* frond
pH			
Initial	6·80	6·60	6·52
After 24 h. incubation	7·05	6·12	6·26
,, 48 ,, ,,	5·73	5·70	5·70
,, 72 ,, ,,	5·03	4·71	4·80
Water content, %			
Initial	87·7	86·7	88·3
After 24 h. incubation	88·0	86·8	87·4
,, 48 ,, ,,	87·6	89·1	86·7
,, 72 ,, ,,	89·0	88·2	87·0
Ash, % (dry basis)			
Initial	40·8	37·0	35·9
After 24 h. incubation	41·1	37·6	35·5
,, 48 ,, ,,	39·5	35·4	34·4
,, 72 ,, ,,	43·5	40·4	35·5
Mannitol, % (dry basis)			
Initial	10·5	9·1	14·8
After 24 h. incubation	12·7	9·5	16·1
,, 48 ,, ,,	9·6	8·7	15·2
,, 72 ,, ,,	2·1	5·1	13·7
Total nitrogen, % (dry basis)			
Initial	2·27	2·00	2·09
Kjeldahl nitrogen, % (dry basis)			
Initial	1·84	1·84	1·93
After 24 h. incubation	2·10	1·79	2·09
,, 48 ,, ,,	2·02	1·80	1·92
,, 72 ,, ,,	2·25	2·07	2·00

identical results. This proved that the loss on drying at 100–105° was water and not volatile matter etc. formed during ensiling.

The *A. nodosum* contained very little inorganic nitrate and, with the exception of a slight increase in the Kjeldahl and the water-soluble nitrogen, no significant changes in composition occurred after incubating or ensiling in the pipe for 102 days. The percentage of soluble nitrogen increased from 24% of the Kjeldahl nitrogen in the initial sample to 30% after 102 days in the pipe, representing 8% protein breakdown, which is considerably less than is found for grass on ensiling. The water content before and after incubating was 66·8 and 67·1% respectively, and the differences in the ash, laminarin and mannitol contents were also insignificant. When the silo was opened after 102 days, except for a trace of mould on the surface of the algae which had been in contact with the soil at the edges, the algae appeared to be unchanged and looked as 'fresh' as when put into the silo. Samples were taken at each foot depth and, with the exception of differences in pH (4·94 at the top increasing to 5·31 midway down and then decreasing to 4·86 at the bottom of the silo), the differences in composition were insignificant. The sample from the bottom of the silo was analysed for acetic and lactic acids and the results of 0·45 and 1·25% respectively (calculated on the fresh weight) are of the

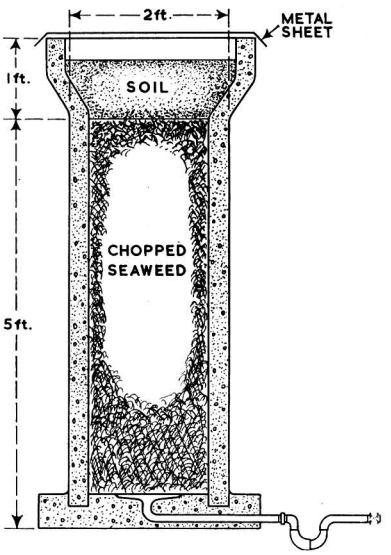

FIG. 2.—*Experimental concrete silo*

Table VI

Ensiling experiment with A. nodosum *collected South Queensferry 4/7/52*

	pH	Water content, %		Composition, % (dry basis)					
		Oven method	Tate & Warren[7]	Total ash	Laminarin	Mannitol	Cellulose	Alginic acid	L-Fucose
Initial sample	6·26	66·8	67·0	19·6	6·2	8·8	4·0	24·3	7·3
After 48 h. incubation at 30°	5·38	66·8	66·3	19·0	6·0	9·7	3·8	24·2	—
After 72 h. incubation	5·00	66·5	65·7	18·6	6·1	10·2	2·3	24·1	—
After 96 h. incubation	5·29	67·0	65·4	18·7	5·3	10·0	2·3	23·2	—
After 120 h. incubation	5·47	67·1	66·8	19·0	4·8	9·4	2·1	23·1	—
After 21 days' incubation	5·43	66·3	65·6	18·8	5·4	10·2	2·5	24·2	7·1
After 102 days' incubation	5·47	67·1	—	19·6	5·3	10·5	1·7	24·0	—
After 102 days in pipe, 0–1 ft.	4·94	67·6	—	20·2	4·5	10·1	1·9	22·3	—
After 102 days in pipe, 1–2 ft.	5·10	67·3	—	19·7	4·3	10·1	1·7	—	—
After 102 days in pipe, 2–3 ft.	5·31	67·7	—	19·8	4·2	9·8	1·6	—	—
After 102 days in pipe, 3–4 ft.	5·11	67·5	—	19·8	3·9	9·2	2·8	24·7	—
After 102 days in pipe, 4–5 ft.	4·86	67·1	—	19·6	4·5	8·4	2·5	24·2	7·4

	Fresh weed			Dried milled weed		
	Kjeldahl nitrogen	Total nitrogen	N.P.N.	Kjeldahl nitrogen	Total nitrogen	N.P.N.
Initial sample	1·36	1·44	0·33	1·44	1·54	0·47
After 48 h. incubation at 30°	1·38	—	0·32	1·45	1·52	0·42
After 72 h. incubation	1·40	1·47	0·37	1·42	1·48	0·51
After 96 h. incubation	1·47	1·47	0·42	1·40	1·45	0·54
After 120 h. incubation	1·41	1·48	0·40	1·47	1·52	0·55
After 21 days' incubation	1·39	1·42	0·38	1·41	1·44	0·45
After 102 days' incubation	1·50	1·55	0·42	1·52	1·55	0·61
After 102 days in pipe, 0–1 ft.	1·51	1·56	0·46	1·51	1·54	0·76
After 102 days in pipe, 1–2 ft.	1·54	1·55	0·46	1·49	1·52	0·68
After 102 days in pipe, 2–3 ft.	1·50	1·55	0·46	1·49	1·55	0·68
After 102 days in pipe, 3–4 ft.	1·55	1·58	0·47	1·55	1·58	0·69
After 102 days in pipe, 4–5 ft.	1·50	1·57	0·44	1·60	1·62	0·67

same order as normally found in ensiled grass. A negative result (— 0·9%) was obtained for butyric acid.

Samples of liquor were drained from the silo at intervals and their analytical figures are given in Table VII. The total weight obtained was 10,540 g., representing 3·1% of the weed in the silo (wet weight). The liquor contained the water-soluble constituents, was particularly high in mannitol (20% of the dry matter) and contained 9·6% of crude proteins (dry basis).

(2) A second ensiling experiment was carried out with *A. nodosum* (6 cwt.) collected at South Queensferry in December, 1952, and the results are given in Table VIII. Before opening the silo, 107 lb. of liquor, representing 16% of the initial fresh weight of the algae, was drained off. As in the previous experiment, preservation occurred with very minor changes in chemical composition, which could be accounted for by the losses in the cell sap drained from the silo.

In the previous experiment, partial drying of the weed occurred on the shore after collection which, no doubt, accounted for the smaller amount of liquor drained from the silo.

(3) L. cloustoni *collected at Loch Feochan, Argyllshire, 7/1/53.*—The *L. cloustoni* (whole plants) was collected at Loch Feochan on 7 January, 1953, and was chopped up and filled into the silo on 9 January. It is probable that some change in composition may have occurred

Table VII

Analysis of liquor drained from* A. nodosum *silo of 4/7/52*

Date	pH	Water content	Total ash	Laminarin	Mannitol	Alginic acid	L-Fucose	Kjeldahl nitrogen
11/7/52, 7 days after closing silo	4·84	84·6	30·6	—	20·3	—	—	—
17/7/52	4·78	85·0	28·7	—	18·9	—	—	—
25/7/52	4·80	84·6	34·5	8·0	17·4	0·6	3·3	1·53
15/10/52	5·06	83·6	32·2	—	7·4	—	—	—

* With the exception of the water content the results are expressed as a percentage of the dried residue.

during this time. At the same time samples were placed in bottles with stoppers fitted with mercury seals and incubated at 30°. The silo was opened up after 60 days and the analytical results of the samples from this experiment are given in Table IX. The material in the silo appeared 'fresh' and unchanged. Analysis, however, showed that there had been some utilization of the laminarin (13·4 to 2·7%) accompanied by a decrease in the mannitol content (13·9 to 8·7%), but with no significant change in the crude proteins. There was an increase in the water-extractable nitrogen, from 0·48 to 1·0%, that is an increase in the percentage of soluble nitrogen from 26 to 55%, representing protein breakdown equal to 39%, which is considerably greater than that found for *A. nodosum* (cf. 8%). Free sugars (estimated as glucose) were found to the extent of 1·46% (dry basis) in the ensiled algae, and the lactic acid content, 2·04% (fresh weight), was again of the same order as that of ensiled grass. The grade of the alginic acid appeared to be unaffected.

From the 737 lb. of chopped weed filled into the silo, 74 lb. of liquor was drained off (10% of total weed) and 630 lb. (86% recovery) was obtained from the silo, accounting for 96% of the alga. The dry material from this liquor was high in ash (56·6%) and mannitol (16·3%) and contained 6·1% of crude proteins and about 5% of fucoidin.

This last experiment with *L. cloustoni* was repeated, but a depth of only 3 ft. of chopped plant was placed in the silo without any soil to exclude air, and a loose cover placed over the top to prevent access of rain. The *L. cloustoni* (whole plants) was collected at Inchcolm on 12 December, 1952, chopped up the following day and packed into the silo. After 97 days the material was examined. The top 6 in. appeared to be in an advanced state of decomposition and smelt strongly of ammonia. Analysis of samples gave the results shown in Table X. These figures would appear to indicate that some preservation can be effected without sealing off the silo with soil, but only at the expense of a certain amount of decomposition in the upper layers.

Summary of results

Experiments on the preservation of the brown marine algae are described. The chemical methods studied include the immersion of the algae in solutions containing bactericides and the treatment of the fresh algae with sulphur dioxide gas.

It is possible to preserve the algae in sea-water containing more than 20% of sodium chloride, but not without major chemical changes in composition. Plasmolysis results in a loss of the soluble constituents into the surrounding aqueous medium and an increase in the ash content of the plant.

The addition of bactericides appears to be effective only at a concentration that 'kills' the plant, which again results in a loss of the soluble constituents. Spraying of the algae with bactericides was not attempted because of the difficulty of ensuring intimate contact. Treatment of the fresh algae with sulphur dioxide gas, followed by exclusion of air, is very effective and very little change in chemical composition occurs.

Table VIII

Ensiling experiment with* A. nodosum *collected at South Queensferry* 3/12/52

Sample	pH	Water content	Total ash	Laminarin	Mannitol	Cellulose	Alginic acid	L-Fucose	Wet weed			Dried milled weed		
									Kjeldahl nitrogen	Total nitrogen	N.P.N.	Kjeldahl nitrogen	Total nitrogen	N.P.N.
Initial	6·52	73·3	22·3	2·6	8·7	2·4	23·3	6·9	1·76	1·82	0·56	2·00	2·07	0·66
After 48 h. incubation at 30°	5·62	72·9	21·3	2·3	8·5	2·3	—	6·0	1·60	1·50	0·63	2·02	2·08	—
After 67 days' incubation at 30°	5·02	75·2	22·7	1·9	7·5	—	21·2	7·1	1·59	1·69	0·50	1·82	1·93	0·35
After 67 days in pipe	4·78	70·4	21·7	2·8	5·7	—	20·6	8·0	1·86	1·99	0·51	1·84	1·77	0·49
Liquor drained from pipe before emptying	4·76	91·5	44·8	2·9	16·9	—	—	1·8	—	—	—	2·03	2·34	—

* With the exception of the water content the results are expressed as a percentage of the dry matter

Table IX

Ensiling experiment with* L. cloustoni (*whole plant*) *collected at Feochan* 7/1/53

Sample	pH	Water content	Total ash	Laminarin	Mannitol	Alginic acid	L-Fucose	Wet weed			Dried milled weed			Wet weed			Viscosity of 0·25% (w/w) soln. of sodium alginate, cs	Free sugars as glucose
								Kjeldahl nitrogen	Total nitrogen	N.P.N.	Kjeldahl nitrogen	Total nitrogen	N.P.N.	Acetic acid	Butyric acid	Lactic acid		
Initial	6·72	82·3	34·8	13·4	13·9	14·2	3·5	1·85	1·76	0·48	1·89	2·02	0·73	—	—	—	13·9	—
After 48 h. incubation at 30°	5·87	82·4	34·8	7·2	12·1	11·4	3·5	1·98	1·90	0·64	1·80	1·87	0·71	—	—	—	—	—
After 60 days' incubation	4·77	84·4	37·5	1·4	2·2	12·6	3·5	2·11	1·96	1·04	2·10	2·24	0·45	—	—	—	—	—
After 60 days in pipe	5·43	81·0	33·3	2·7	8·7	16·2	4·0	1·80	1·73	0·99	1·72	1·88	0·64	0·87	−0·39	2·04	11·5	1·46
Liquor drained from pipe before emptying	5·16	89·3	56·6	nil	16·3	—	2·9	—	—	—	0·98	1·05	—	—	—	—	—	—

* With the exception of the water, acetic, butyric and lactic acid contents, the results are all expressed as a percentage of the dry matter

Table X

Sample		pH	Water content, %	Dry basis Mannitol, %	Dry basis Ash, %	Dry basis Kjeldahl nitrogen, %
Original		6·70	84·0	10·1	34·7	2·65
After 97 days	Top 6 in.	7·32	87·3	1·5	44·2	3·16
	Remaining 2½ ft.	5·09	84·1	2·0	27·7	3·15
	Liquor drained off	5·04	92·9	1·2	60·4	1·89

The ensiling of algae has been studied both on the laboratory and on the pilot scale and it has been found that they support a vigorous lactic acid fermentation and can be ensiled without inoculation or the addition of fermentable carbohydrates.

The chemical changes that occur in algae on ensiling depend on the initial composition of the material, and the extent of the change, therefore, depends on the time of year at which the algae are harvested. With *A. nodosum* very little change in composition occurs with season, and preservation can be accomplished by ensiling, the only significant change being an increase in non-protein-nitrogen at the expense of the protein-nitrogen. With *L. cloustoni*, marked seasonal changes occur in the chemical composition. If harvested in the spring of the year when the plant contains inorganic nitrogen, and laminarin is absent, ensiling results in protein synthesis with utilization of the mannitol. If harvested later in the year, when inorganic nitrogen is absent and laminarin is present, fermentation results in the utilization of the laminarin and a breakdown of proteins. Consequently, the preservation of *A. nodosum* can be accomplished with considerably less change in chemical composition than *L. cloustoni*.

It is reasonable to assume that similar results would be obtained if the size of the silo is increased from 6 cwt. to 20 tons. Recent work at the Edinburgh and East of Scotland College of Agriculture (private communication) has shown that the results obtained with grass in concrete silo pipes, of a capacity approximately equal to that used in the present investigation, are similar to those obtained in silos of the order of 20 tons.

One of the main objectives of this work has not been fulfilled. It was intended to carry out digestibility trials with sheep at the Edinburgh and East of Scotland College of Agriculture, but, unfortunately, the breed of sheep available would not accept the ensiled algae.

Acknowledgments

This work forms part of a programme of research and development undertaken by the Institute of Seaweed Research, and the author is indebted to the Institute for permission to publish. He wishes to thank Professor S. J. Watson and the staff of the Edinburgh and East of Scotland College of Agriculture for their valuable advice, and for carrying out the preliminary experiments. Thanks are also due to Mr. W. J. Cornhill and Mr. J. C. Paterson for assistance with the analytical work.

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Received 20 May, 1954; (amended manuscript) 3 September, 1954

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A STUDY OF THE USE OF A SMALL PANEL TO ESTIMATE CONSUMER JUDGMENTS

By J. H. PRENTICE and D. SHEPPARD

Two methods of validating the judgments made on butter, compound fat and margarine by a small panel are described. In each case the panel's judgments, made to a rating scale, were compared from time to time with the judgments of larger, consumer, groups. In the first method the averages of the panel members' ratings for each attribute were compared with the averages of the consumer group's ratings, and significant regression coefficients were obtained for the attributes flavour, spreadability and firmness. The panel and the consumers did not agree about texture or overall quality. In the second, fuller, method, the individual panel members' judgments were examined for self-consistency and possible drift with time, and multiple regression equations were calculated for the estimation of consumer judgments from the panel members' judgments for each attribute.

Introduction

Two series of experiments were recently carried out at the National Institute for Research in Dairying, to study ' objective ' means of assessing such attributes of butter, margarine and cooking fat as ' spreadability ' and ' firmness ', which are most important to the user, and yet are not capable of precise physical definition. For this purpose several instrumental tests of an empirical nature were developed[1] and measurements made with these were compared with subjective assessments on the same samples. The experiments, which will be referred to below as the main experiments, extended over periods of several months, and since it was not possible to keep typical samples of these materials unchanged over such periods, so that they might serve as standards for comparison, the subjective ratings had to be made to memory standards. This is, of course, common practice in grading, but much research has shown it to be unsatisfactory.[2–5] A common way of testing for the acceptability of a food product is to ask large numbers of typical consumers to rate the product for the qualities that are expected to be important.[6] This procedure becomes impracticable when it is necessary to have judgments made regularly and frequently during long-term experiments. Some compromise may be effected by employing a large panel of judges,[7] but in the present case even this was quite impossible. Only a few judges were available regularly over these long periods ; none of them had had any practical experience of grading, although each was familiar with handling the materials in the physics laboratory. It was thought possible that such non-expert judges might give judgments unrepresentative of those that would be given by a large ' consumer ' group. Moreover, since no objective criterion or standard sample was available, it could not readily be discovered whether the judges were becoming more or less critical of the attributes they were rating as the experiments proceeded.[8] An attempt was therefore made to standardize the panels' judgments by comparing them with those of larger consumer groups on samples of the materials similar to those being assessed during the long-term experiments. These comparisons were made at intervals throughout the main experiments. This is, in fact, a development of a method used by Hopkins[9] in which the assessments made by each member of a large tasting panel were compared with the average assessment of the other judges, in order to establish whether or not that member could be regarded as conforming to the group.

In the present paper two ways of studying the relationship between the assessments made by a small panel, and those made by larger consumer groups, are described.

Experimental procedure

In the first main experiment many different types of the three materials were tested at various temperatures, and subjective assessments were made for the following attributes: flavour intensity, flavour quality, spreadability, texture, firmness and overall quality. No definitions of these attributes were given, and the judges were left to put their own interpretation upon the terms. Seven-point ' graphic ' rating scales were used throughout, and these were converted arbitrarily into scores on a linear scale. Thus a score of one point was given for a ' very good ' flavour, two points for ' good flavour ', and so on, to seven points for a ' very bad ' flavour.

Sheppard[10] has shown that such terms do not represent a linear scale, and the interpretation of the terms varies from one person to another. Nevertheless, there were appreciable similarities in these interpretations, and it was thought unnecessary in the present case to make any correction for lack of linearity of the rating scales. In the second main experiment, only a few types of two materials were studied to find out what changes occurred during storage over a period of about six months. Firmness was not assessed in this series.

The procedure used to validate the panels' assessments was to obtain judgments on the same days and on the same materials from the members of the panel and from larger consumer groups. Neither the members of the panel nor the members of the larger consumer groups had any prior knowledge of the identity of these samples, and each was presented under a code letter. They were, however, told which was butter and which was margarine, and they were asked to judge margarine ' in its own right ' and not as a substitute for butter. The materials used on these ' test days ' were similar to those used in the main experiments, and were selected with the object of obtaining a wide yet fairly typical range of qualities. In the second series, on each test day, one butter sample and one margarine sample from the main experiment were included in the hope that any changes which had occurred in them during that experiment might be detected by the consumer groups, even if the panel had failed to notice them through becoming ' adapted ' to the gradual changes in quality. One test day was held at the beginning, and one at the end, of each main experiment. In the first main experiment one was also held about half-way through ; in the second, one was held three weeks after the experiment had commenced and the other some six weeks later. Approximately the same number of samples was assessed in the main experiments in each interval between these test days.

The samples used on the test days were subdivided into a sufficient number of small sub-samples for each judge to be provided with a fresh one. They were all brought to a steady temperature of 50° F before the test, and held at that temperature throughout the day by the use of vacuum flasks, from which they were removed only immediately before presentation to the judges. When each sub-sample had been assessed it was discarded. By this means variations in the properties of the materials due to any variations in the ambient temperature during the day were reduced to a minimum, and it is reasonable to assume that the samples were in the same condition for each judge.

Normally, when obtaining consumer judgments for food products, the experimenters try to collect as large a group as possible of ' typical ' consumers to rate the products. In this case, however, certain of the attributes, for example texture, could properly be judged only by ' experts ' ; so, in addition to a group from the general public, groups of canteen workers and personnel from the research dairies were asked to give their judgments. The full test took each person some 15–20 minutes to complete, particularly in the first series, and as a result, the control groups were never very large. The number of people in addition to the panel who completed the tests were 27, 19 and 48 respectively on the three test days of the first series, and 62, 85, 108 and 118 in the second series. The composition of the ' general ' group varied from test day to test day, although as far as possible those people who judged on the first test days also took part in the later tests. The composition of the canteen and dairy groups remained fairly constant during each series, but the personnel changed slightly between the two series. There were three members in the panel for the first series, and in the second series six members, two of whom were in the original panel.

Results

In the first series each person judged one sample of each of the three materials on each test day. The judgments made by the three panel members were averaged to obtain the panel scores. Similarly, the control-group scores were obtained as the mean of the scores given by the individual members of the groups. Correlation coefficients between panel scores and general-public scores were computed for each attribute assessed. These coefficients were significant at the 0·1% level for flavour quality and spreadability, at the 2% level for firmness and at the 5% level for flavour intensity. The correlation coefficients for texture and overall quality were not significant at the 5% level. Analyses of covariance were used to examine the data for each attribute, using the consumer scores as the control. For no attribute was there any significant

effect, either between days or between materials. It would appear then that the panel's judgments were linearly related to those of the control group, and that the relationship was the same for all three materials and on all three test days. Consumer judgments on the test days could not have been affected by adaptation, as they were not concerned in the main experiments. Had the panel been affected, this would have appeared as a significant ' between days ' effect in the analyses of covariance.

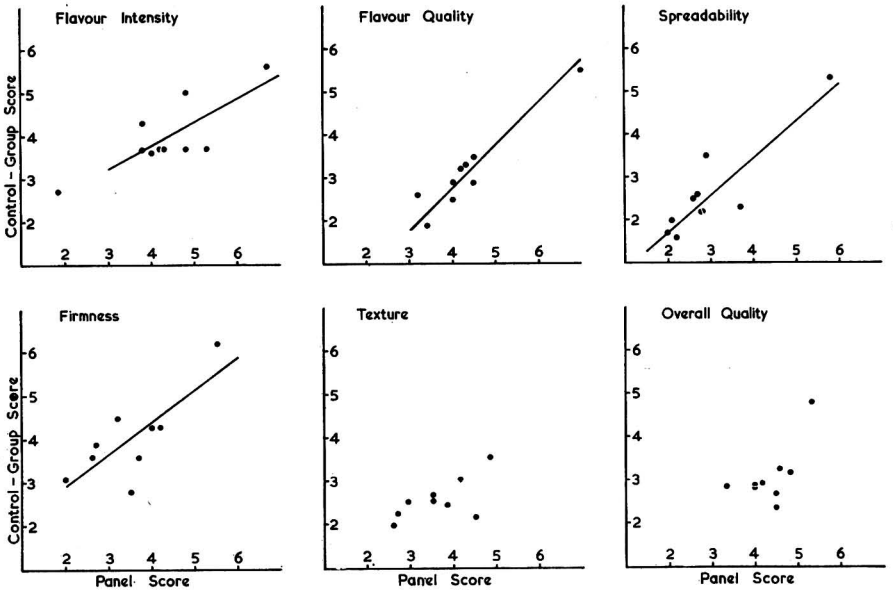

FIG. 1.—*Relation between consumer-group scores and panel scores for various attributes*

Fig. 1 shows the panel scores plotted against the consumer-group scores for each attribute, together with the regression line for estimating the consumer scores from the panel, where the correlation is significant. It can be seen from Fig. 1 that the residual variance due to scatter of the points about the regression lines differs considerably for the different attributes, as is indicated by the different significant levels of the correlation coefficients quoted above. If the regression lines are used to estimate the consumer scores from the panel scores the standard error of these estimates will be small for the attributes spreadability and flavour quality, rather larger for firmness, and quite considerable for flavour intensity.

It has already been noted that the general public could not be expected to give a useful assessment of texture, and indeed some of them commented that they did not understand this concept. It is not surprising, then, that the panel scores were not significantly correlated with the scores for texture given by the group drawn from the general public. When the panel scores were compared with the scores given by a group consisting of personnel of the research dairies, it was again found that there was no significant effect in the analysis of covariance, but also that the correlation coefficient was not significantly different from zero. It must be concluded that the panel judged texture differently from the dairy personnel, and this was probably due to a difference in interpretation.

The members of the panel, as well as the members of the larger group, found ' overall quality a difficult concept. Apart from one margarine which was by common consent of poor quality, the members of the public differentiated but little between the samples, which most of them rated as ' fairly good '. The panel gave overriding importance to flavour quality in assessing overall

quality, and it was noticeable that the panel scores for these two qualities were quite similar (correlation coefficient 0·69).

In the second series each subject judged three samples of butter and two samples of margarine on each of the four test-days, so that twelve samples of butter and eight samples of margarine were judged in all. Unfortunately it happened that the margarine samples were not sufficiently different to enable either the panel or the consumer groups properly to discriminate between them; and in the following discussion only butter has been considered.

In this series two members of the previous panel were available, together with four new members, who had not had previous experience of this type of work. It was, therefore, not thought that the judgments of each member of this panel should be assumed to be equally important. Since there was a greater number of samples of each type of material in this series, these data were more exhaustively analysed.

Thus since the samples were kept at a constant temperature in vacuum flasks during each test day, the samples judged by the panel in the morning and the evening could be considered true replicates, and it was possible to examine the self-consistency of the individual members of the panel in judging each attribute. This was done in two ways: the ' reliability coefficient ' was calculated as the correlation coefficient between the morning and evening scores, and also the ' between samples ' variance was compared with the ' between replicates ' variance. There are three possibilities: (i) the reliability coefficient is significant, and the ' between samples ' variance is significantly greater than the ' between replicates ' variance; this arises when the judge is discriminating adequately between the samples. (ii) The reliability coefficient is significant, but the ' between samples ' variance is not significantly greater than the ' between replicates ' variance; this arises when the judge shows a consistent shift in judgment between morning and evening, but otherwise is discriminating between the samples. (iii) Both are insignificant; this occurs when the judge is not discriminating between the samples, either because he is making large random errors in the replicate judgments, or because there are too small differences between the samples. In fact, the second case did not arise. There were always sufficient differences between the samples for some members of the panel to discriminate, although not all might be able to do so.

Before proceeding further with the analysis, those members who had not discriminated between the samples were eliminated from the panel. Next, the individual members' scores were compared with the control groups by means of analysis of covariance, as in the first series. This treatment does not distinguish between random variation from test day to test day and a drift such as might be due to a progressive shift of the observers' mental standards. It was therefore necessary to examine individually each case in which a significant ' between-days ' effect occurred in the analysis of covariance. The deviations of the average of the observers' scores on each day from the average of the control-group scores for that day were plotted serially against the number of the test day. In this form of plotting, a progressive drift shows up as a line whose slope is of the same sign throughout. A random variation appears as a wavy line. In Fig. 2 these average deviations from day to day have been plotted for each observer for each attribute, and it is easy to see for which members of the test panel there was a progressive drift. These members were then eliminated from the panel.

It only remained to assess the relative weights to be accorded to the accepted members of the panel in order to obtain from their scores the best possible estimate of the control groups' scores. It was noticeable that, in general, the members of the panel gave less favourable judgments than the control groups[11] and the following treatment allows for this. Correlation coefficients were calculated from the scores of each pair of members of the panel and also for each member with the control group. The appropriate weights could then be determined directly from this matrix of correlations.[12] By proceeding in this way, multiple regression equations were obtained for each attribute in turn: writing a for judge A's score, b for B's score and so on, these were:

Flavour intensity	$= 0{\cdot}67e + 0{\cdot}03f + 0{\cdot}12a + 0{\cdot}03d$	$r_m = 0{\cdot}80$
Flavour quality	$= 0{\cdot}87e + 0{\cdot}17d - 0{\cdot}18c$	$r_m = 0{\cdot}81$
Spreadability	$= 0{\cdot}58a + 0{\cdot}27e + 0{\cdot}27f - 0{\cdot}02d$	$r_m = 0{\cdot}93$
Texture	$= 0{\cdot}60e + 0{\cdot}38f + 0{\cdot}12d - 0{\cdot}12c$	$r_m = 0{\cdot}86$

These equations refer, of course, to scores in standard measure and indicate the relative weights to be given to the judgments of the individual panel members. The accuracy with which the regression equations estimate the control groups' scores is indicated by the multiple correlation coefficients, r_m, which are given alongside. Since the original correlation coefficients were

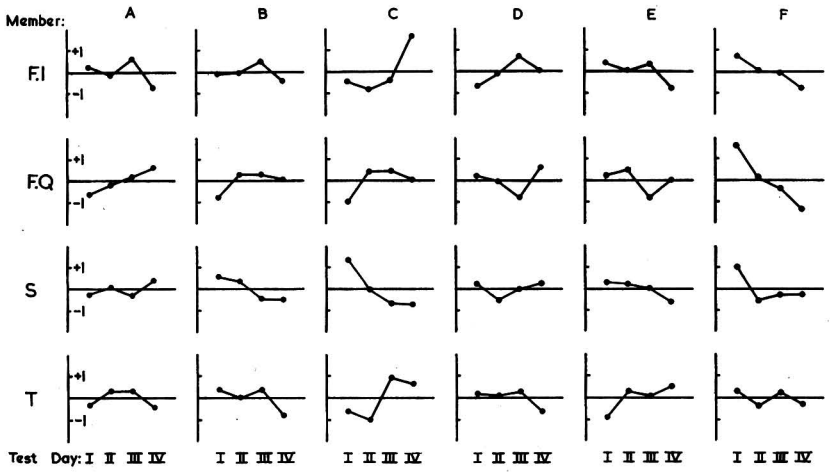

FIG. 2.—*Drift of judgments by individual panel members*

calculated from data on only twenty-four samples, they were subject to fairly large standard errors, and the regression coefficients obtained from them are subject to even larger errors. The regression coefficient for judges F and D for flavour intensity and for D for spreadability are, in fact, not significantly different from zero, and these members were also eliminated from the panel for those attributes.

Finally the equations given above, after eliminating non-significant terms, were converted to give estimates of the control groups' scores from the panel members' scores. These equations were:

$$\begin{aligned}
\text{Flavour intensity} &= 0{\cdot}29e + 0{\cdot}05a + 1{\cdot}83 \\
\text{Flavour quality} &= 0{\cdot}78e + 0{\cdot}12d - 0{\cdot}14c + 0{\cdot}44 \\
\text{Spreadability} &= 0{\cdot}31a + 0{\cdot}14f + 0{\cdot}13e + 0{\cdot}77 \\
\text{Texture} &= 0{\cdot}20e + 0{\cdot}19f + 0{\cdot}05d - 0{\cdot}03c + 1{\cdot}28
\end{aligned}$$

These regression estimates of the control groups' scores have been plotted against the actual scores in Fig. 3. It is interesting to compare the correlation coefficients between the regression estimates and the control with those obtained between the panel average scores and the control. Using the same panel members as were used to obtain the regression estimates, the correlations were respectively:

Flavour intensity	0·69	Flavour quality	0·47
Spreadability	0·92	Texture	0·76

For those attributes that could be easily defined and were well understood, little loss of accuracy would have resulted from taking the panel average instead of the weighted scores. At the other extreme, where a difficult concept was involved, as in flavour quality, the panel average bore no significant relation to the control group, yet the regression estimate was highly significantly related. This was due very largely to the high correlation between E's scores and the control; E's scores alone would have yielded almost as accurate an estimate (correlation coefficient 0·79).

Discussion

The technique that has been described above served its purpose very well, and it was

possible to detect trends in judgments made by the panel, and to allow for any biases by means of it. In addition, results obtained by the two methods of analysis made it possible to determine the usefulness of judgments made by the panel for the different attributes, and to assess the validity of these judgments in terms of assessments made by consumer groups, or, when more appropriate, by groups of specialists. It is particularly noteworthy that in the first main experiment the very small panel of only three judges proved to be a reliable guide when estimating consumer opinion for several of the attributes of the materials. The degree of precision

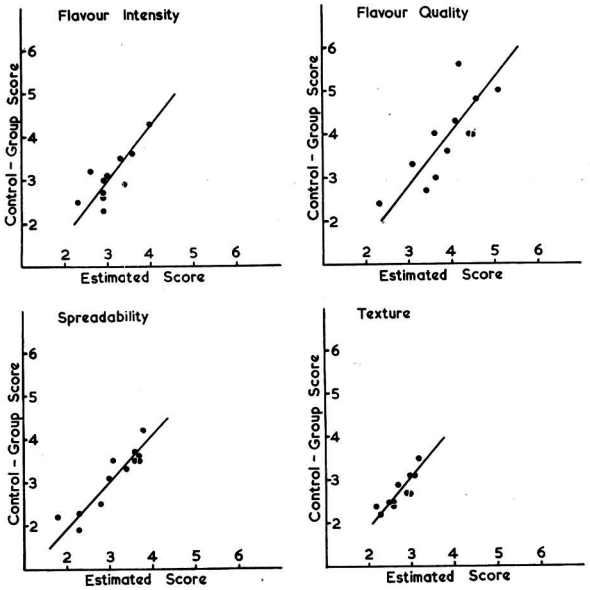

FIG. 3—*Comparison of control-group scores with regression estimates from panel scores (second series)*

of the estimates of consumer opinion which could be made differed with the different attributes, and in general the easier the concept, the greater the precision. In the first experiments the choice of the members of the panel was fortuitous, but it is suggested that by using the methods described for the second series, to reject judges who are atypical or unreliable, it would be possible to make good use of very small panels in circumstances where larger panels, or full-scale consumer tests, would be unwieldy or quite impossible.

Acknowledgments

The authors wish to acknowledge the assistance given by members of the staff of the National Institute for Research in Dairying, the Commonwealth Bureau of Dairy Science and the University of Reading; the Shinfield and the Earley Women's Institutes, the Reading Townswomen's Guilds and the Warden and members of the South Reading Community Centre, who all took part in the experiments. They wish to thank Dr. E. C. Bate-Smith and Dr. G. W. Scott Blair for helpful discussions and advice, Miss S. Carrinci and Miss A. Dawkins for assistance in the computation, the Ministry of Food for supplying the samples and the Agricultural Research Council for a grant to one of them (D. S.).

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Received 17 March, 1954; (amended manuscript) 21 July, 1954

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THE EXPRESSIBLE FLUID OF FISH FILLETS. I.—Nucleic Acid as an Index of Cell Damage in Fillets Frozen from Both Sides

By R. M. LOVE

The appearance of deoxypentosenucleic acid (DNA) in muscle expressible fluid has been taken to indicate rupture of the sarcolemmas, with liberation of nuclear material. When fish fillets are frozen more and more rapidly, the expressible nucleic acid suddenly rises to a maximum, which is thought to correspond with the point of formation of intracellular ice crystals. In ultra-rapid freezing, there is also a rise in expressible DNA, probably owing to a different kind of cell damage.

Introduction

Studies on the freezing of fish,[1] meat[2] and poultry[3] have shown that, when muscle is frozen slowly, water is withdrawn from the tissue to form large masses of ice between the fibres, which are thereby distorted and pushed into clumps. When such greatly disorganized tissue is thawed, much 'drip' exudes, presumably because some of the extracellular water is free to escape from between the fibres before it can be reabsorbed by them. ('Drip' is defined as the cloudy fluid exuding from fillets which are allowed to stand for some time under humid conditions. If pressure is applied, a product of somewhat different composition is obtained, which is called 'expressible fluid' throughout the present work.[4]) On the other hand, rapidly frozen muscle retains much of the microscopic appearance of unfrozen tissue, the ice particles formed being numerous, very small and contained wholly within the fibres. On thawing the muscle, the water, being already *in situ*, does not to any appreciable extent escape as 'drip'. On the basis of such findings it has long been considered desirable to freeze flesh foods as rapidly as possible.

A closer consideration of what happens when muscle is frozen, slowly or rapidly, and then thawed must take into account not only spatial disorganization of water distribution due to freezing, but also possible rupture of the sarcolemmas and the powers of reabsorption or rehydration of the cell proteins.

From an examination of microscopic sections of frozen meat, Hiner, Madsen & Hankins[5] concluded that rapid freezing caused more damage to the individual cells than slow freezing, owing to expansion of the intracellular fluid. The effect increased as the tissue was frozen more rapidly, and at the most rapid rate examined nearly every fibre was ruptured. These observations contradicted the results of earlier work[3] in which tissue was frozen sufficiently rapidly for intracellular ice formation, but in which the sarcolemmas appeared sufficiently elastic to withstand the swelling. More recently, Woolrich[6] concluded that cells were not split in freezing, except where the tissue had been mishandled. A suggestion was put forward[3] that in slow freezing the cell fluid is withdrawn into the interstitial spaces without rupturing the sarcolemmas.

It was the object of the present work, in which fish fillets were used, to re-examine the question of tissue damage in freezing, in order to find out, if possible, which of the conflicting views

was correct. A new approach was made by seeking to demonstrate the presence of cell components, in particular deoxypentosenucleic acid (DNA), in fluid expressed from the fillets, on the assumption that they would appear only when the muscle fibres had been burst open, and so provide an index of cell damage.

Material

Cod fish between 20 and 24 in. long were used. They were stored in ice, after catching and gutting, for not more than 5 days, and were filleted just before each experiment by a professional filleter.

Methods and apparatus

Freezing.—The conditions of freezing varied with each experiment, and are described below. Temperatures were measured at the centre of the thickest part of each fillet by a copper–constantan thermocouple, secured in position with thin string. Readings were plotted and the freezing time for purposes of comparison was taken as that required for the temperature to fall from 0° to − 5° (corresponding to solidification of most of the tissue water). With the exception of fillets with freezing times of less than 10 minutes, temperatures were observed every 5 minutes for the first 2 hours, and every 10 minutes thereafter. Currents from the thermocouples were converted into temperatures with a Honeywell–Brown direct-reading potentiometer. In the sample which took 2200 minutes to freeze, a Honeywell–Brown automatic recording instrument was used.

Thawing.—All fillets were thawed by leaving them overnight at room temperature (about 15°) in covered metal trays.

Collection of expressible fluid.—The fillets were suspended round the inside of the apparatus designed by Banks.[7] This consisted essentially of an upright cylinder of perforated stainless steel, closed at the bottom ; it accommodated up to six fillets, which were separated from the walls by strips of muslin. A rubber bladder was also placed inside, and inflated to a pressure of 7 lb./sq. in. This pressure was communicated to the fillets, which exuded fluid. After 6 hours at 2·5°, the pressure was released, the bladder removed, and expressed fluid collected from the bottom of the can with a pipette and stored at 0° until required.

Separation of deoxypentosenucleic acid (DNA).—The method of Schmidt & Thannhauser[8] was used to separate the DNA from 5- or 10-ml. aliquots of expressible fluid. It has been pointed out[9] that DNA prepared in this way may contain as much as 4% of ribonucleic acid (RNA), and in order therefore to reduce the contamination, the DNA-protein precipitate was redissolved in 5 ml. of potassium hydroxide solution and reprecipitated with acid. The precipitate was ashed by incubating with 2 ml. of 10N-sulphuric acid in an oven at 180° with a few ml. of 100-vol. hydrogen peroxide added, a few drops at a time, every 30 minutes, until the solution cleared. The final heating was continued for at least 30 minutes to destroy any remaining peroxide, after which. 2 ml. of water was added and the mixture heated at 100° for 30 minutes, in order to hydrolyse any pyrophosphate that might be present.

From studies with radioactive phosphorus, it has been shown[10] that, when a tube containing phosphate and sulphuric acid is heated over a naked flame, there may be considerable absorption of phosphorus by the glass, with consequent low results (see also Martland & Robison[11]). The present method is free from this error.

Estimation of phosphorus.—The method of Berenblum & Chain[12] was used. Normally a tedious method, it was speeded up by the use of a shaking machine and automatic burettes and pipettes, until up to 24 coloured solutions could be prepared per hour. The optical density of the blue solution was measured at 730 mμ with a Unicam S.P. 500 photoelectric spectrophotometer, by using 1-cm. glass cells.

Loss of weight in fillets.—The percentage loss of weight through expression of fluid was calculated from the weights of the fillets before freezing and after pressing.

Solids and nitrogen in expressible fluid.—Expressible fluid (10 ml.) was pipetted into a tared evaporating basin. An equal volume (approx.) of 95% ethanol was added, and the whole dried to constant weight in an oven at 100°. Nitrogen was determined by the standard Kjeldahl procedure.

Microscopic sections.—Slices of tissue about 5 mm. thick were cut with a fine-toothed hand saw from the thick ends of the fillets, while still frozen, at right angles to the skin. These were dried in a vacuum over phosphorus pentoxide, and small cubes cut from them were placed straight into melted paraffin wax, according to the technique of Koonz & Ramsbottom.[3] Sections 10 μ thick were cut with a rotary microtome, and stained with haematoxylin and eosin. The section of unfrozen fish illustrated as a control was made from fish hardened in Bouin's fluid, then dehydrated in progressively concentrated alcohol, cleared in xylol and embedded in paraffin wax, as in the standard technique.

Results

If it were true that cell damage increased with the freezing rate, then a corresponding increase in expressible-fluid nucleic acid might be expected. The following preliminary experiment (Table I) shows this to be so, except for the unexpected drop in the most rapidly frozen group. Actual rates of freezing were not measured, but fillets were treated so as to give as great

Table I

Deoxypentosenucleic acid phosphorus (DNAP) in the expressible fluid of cod fillets treated in different ways

Treatment	Expressible fluid as loss of wt., %	DNAP (mg. per 100 ml. expressible fluid)
Unfrozen	9·5	0·156
Frozen in still air at − 10°	10·3	0·209
Frozen in still air at − 30°	9·1	0·404
Frozen in air-blast at − 30°	10·4	0·628
Frozen in powdered solid CO_2 at − 78°	10·2	0·324

a difference in freezing rate as conveniently possible. There were 6 fillets (3 cod) in each group, each wrapped in a single layer of aluminium foil 0·025 mm. thick to prevent drying. One aliquot of expressible fluid was taken from each group for analysis, and the DNA was isolated and estimated in triplicate as phosphorus.

It will be noticed that the weight lost by the fillets through expression of fluid did not vary much with the different treatments.

Five other phosphorus fractions were obtained by the procedure employed, namely acid-soluble phosphorus, lipid phosphorus, ' phosphoprotein ' phosphorus, phosphorus insoluble in potassium hydroxide solution, and RNA phosphorus. Values for all these fractions were obtained in both this and the subsequent experiment, but none, except the RNA phosphorus, showed any significant difference between frozen and unfrozen fish. The RNAP fluctuations followed those of the DNAP fairly closely, but, as it was more laborious to estimate RNA under the Schmidt–Thannhauser conditions, it was decided subsequently to work up and estimate only the DNA fractions. A repeat experiment showed a similar drop in the DNAP content of the juice of the most rapidly frozen group, and it was thought desirable to investigate the effect more fully.

In the experiment described next, a group consisted of 6 fillets, each from a different fish. The rate of freezing was measured in one fillet from each group. The DNAP concentrations in the expressible fluid are illustrated in Fig. 1. Four aliquots of fluid were taken at each rate of freezing, and phosphorus analyses were done in triplicate on each aliquot. Each point on the Figure is therefore the mean of 12 determinations, and the standard deviations are shown. Other data from the same fish are given in Table II.

There is a tendency for the values of nitrogen and solids (Table II) to vary with freezing time in a manner similar to DNAP (Fig. 1), both being higher in frozen than in unfrozen fish, and both having a high value at 131 minutes' freezing. However, unlike DNAP, the nitrogen and solids values were highest of all after freezing in liquid oxygen (1·5 min.), and the values also showed more random fluctuations.

Longitudinal sections of the frozen tissue were photographed and are shown in Figs. 2 and 3. Sections corresponding with all the points on Fig. 1 are shown, with the exception of the fish frozen in carbon dioxide–alcohol (2·2 minutes) and in air-blast at − 30°, wrapped in paper

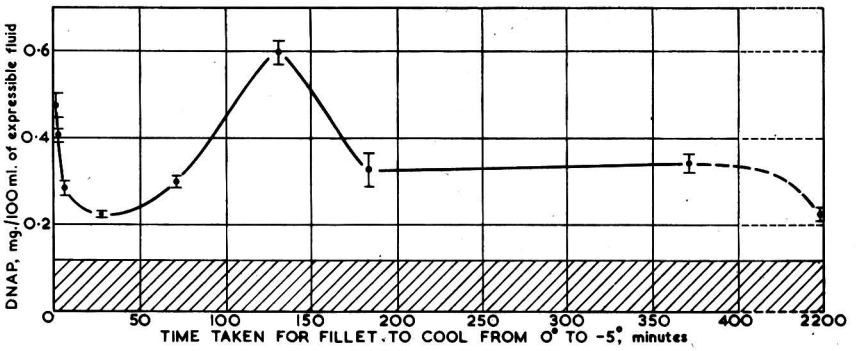


FIG. 1.—*Deoxypentosenucleic acid phosphorus (DNAP) in the expressible fluid from thawed cod fillets that had been frozen at different rates; that from unfrozen fillets is represented by the shaded area.*

(185 minutes). All magnifications are the same. A picture of sectioned unfrozen fish, somewhat broken up, is included for comparison. Two examples are shown of tissue frozen at the rate where DNAP is maximal, i.e. at 131 minutes, in order to give more opportunity for examination. Apart from obvious tears in the tissue, as in pictures A and B, and spaces beyond the edge of the section as in C and E, the clear spaces are considered to have been occupied by ice in the original frozen fish.[3] The narrow band of tissue which runs across some sections, notably B, is some of the connective-tissue partition between myomeres (myocomma). The small round objects, seen in some of the photographs, are artifacts resulting from dust particles in the optical system.

The tissue (B), frozen in liquid oxygen (1·5 min. freezing time), is similar in appearance to unfrozen fish (A), except for the greater shrinkage and tearing of the latter caused by the technique employed. However, a great number of tiny spaces can be seen in B, which represent intracellular particles of ice. In C, with a freezing time of 6 min., the particles have become long columns. However, the sarcolemmas are still intact, and the ice is wholly within the fibres, which remain parallel. Little change is seen in D (28 min.), apart from an increase in the width of the ice columns. In E (71 min.), the size limit of intracellular ice appears to have been reached, since almost the whole of each cell is filled with ice, and the remaining matter is compressed into a narrow strip. The sarcolemmas, still intact, are, however, parallel. F and G (131 min.) are taken from fish which had the highest DNAP concentration in the expressible fluid. In these two photographs the sarcolemmas no longer lie parallel, and appear to have been burst open in several places. It is probable that such large ice columns have formed within the fibres that the sarcolemmas have not been sufficiently elastic to withstand the volume increase. In H (372 min.) the DNAP level has fallen again, and some of the columns of ice are larger still. It will be observed, however, particularly at the bottom of the picture, that whole apparently ' unfrozen '

Table II

Some components of the expressible fluid from thawed cod fillets which had been frozen more and more rapidly

Cooling medium	Freezing time, min.	Expressible fluid as loss of wt., %	Nitrogen, g./100 ml.	Solids, g./100 ml.
B. Liquid oxygen	1·5	10·4	1·525	10·10
B. Alcohol cooled with solid CO_2	2·2	11·2	1·324	9·10
F. Powdered solid CO_2	6·0	12·1	1·337	9·40
G. Powdered solid CO_2	28·2	6·6	1·324	9·12
F. Air-blast at − 30°	71·0	13·1	1·451	9·81
F. Still air at − 30°	131·0	14·5	1·451	10·06
G. Air-blast at − 30°	183·0	12·3	1·392	9·43
F. Still air at − 20°	372·0	11·8	1·421	9·66
F. Still air at − 5°	2200·0	15·5	1·393	9·47
Unfrozen	—	9·5	1·150	8·20

B = bare fillets; F = fillets wrapped in 1 layer of aluminium foil, 0·025 mm. thick; G = fillets wrapped in 2 layers of greaseproof paper and 1 layer of foil

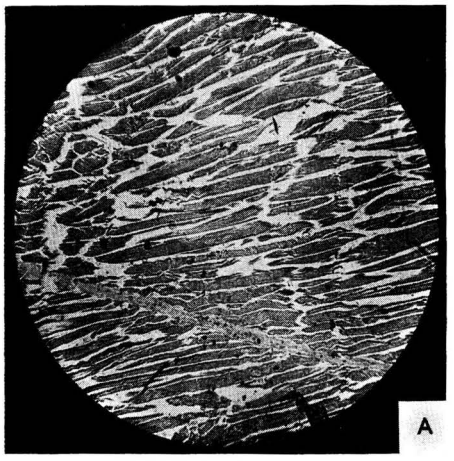
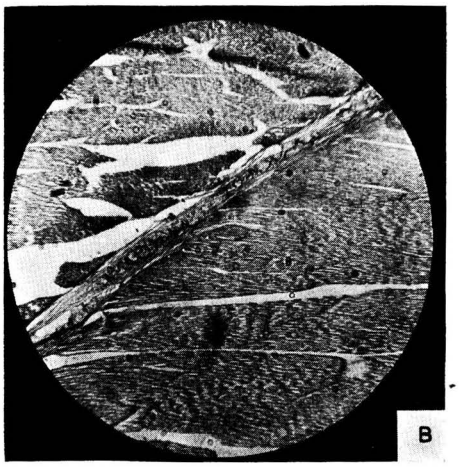
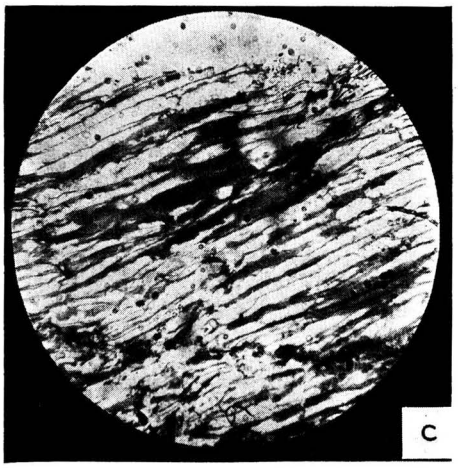


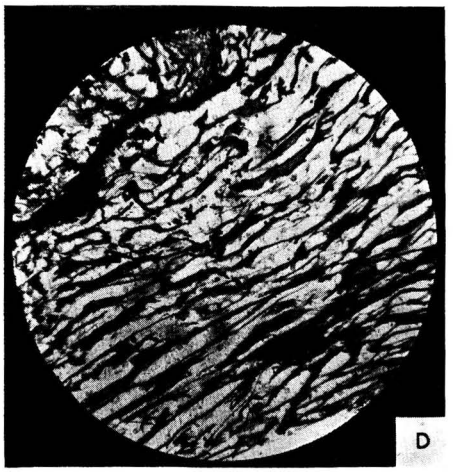
FIG. 2.—*Longitudinal sections of cod muscle frozen at different rates*

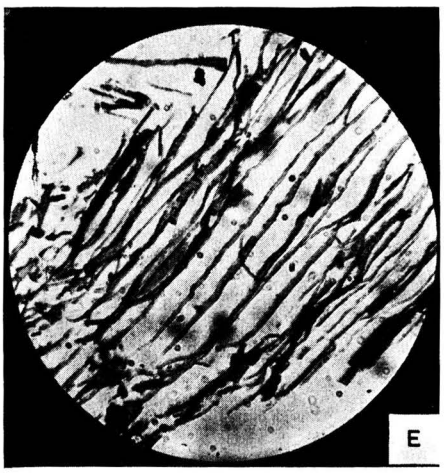
(*The times given in brackets in the captions for Figs. 2 and 3 are those for the fillets to cool from* 0° *to* −5 °. *The original magnification of the photographs in Figs. 2 and 3 was* × 26·5, *but they have been reduced by about one-third for the purpose of blockmaking.*)

A Unfrozen
B Frozen in liquid oxygen (1·5 min.)
C Frozen in powdered solid CO_2 (6 min.)
D Frozen in powdered solid CO_2, wrapped in two thicknesses of greaseproof paper (28·2 min.)
E Frozen in air-blast at − 30° (71 min.)









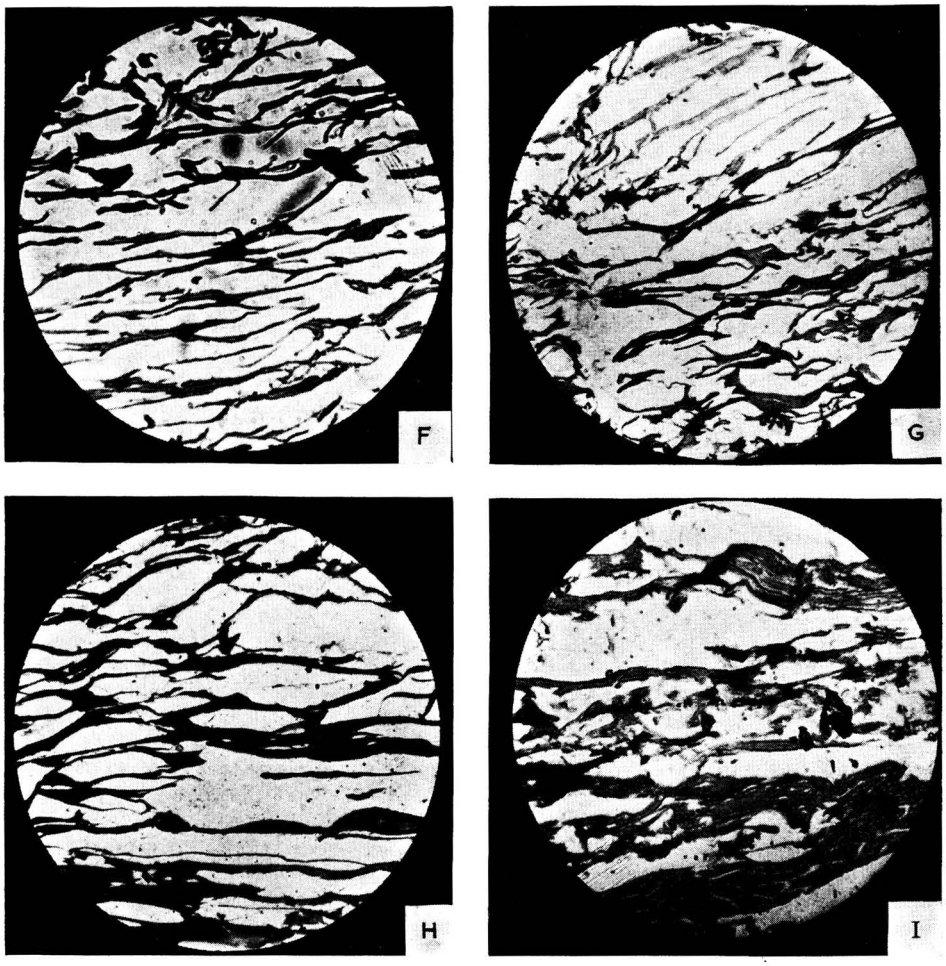


FIG. 3.—*Longitudinal sections of cod muscle frozen at different rates*

F, G } Frozen in still air at − 30° (131 min.)
H Frozen in still air at − 20° (372 min.)
I Frozen in still air at − 5° (2200 min.)

fibres are present, and some intact sarcolemmas can faintly be seen. These fibres are, probably, merely dehydrated, much of their tissue water having diffused out to augment the large intercellular ice columns. Considerable warping of the fibres is shown. The effect is much more pronounced in the last photograph (I), which depicts fish with a freezing rate of 2200 min. Here, several partially dehydrated fibres are packed together and the masses of ice are bigger still. The folding and buckling of the fibres is well illustrated.

Some cross-sections were also made, but sectioning was more difficult and the finished specimen was often a meaningless jumble of tissue fragments, so illustrations have not been included.

Discussion

The occurrence of DNA in the expressible fluid of unfrozen fillets is surprising, since it has already been reported to be absent from salt[13] and aqueous[14] extracts of fish muscle. Possibly

the DNA concentration in such extracts was so small as to escape detection. It is likely that its presence in fluids obtained by the present pressure technique is due to its escape from the severed ends of the fibres on the cut surface of the fillets, and evidence will shortly be given[15] to support this view.

Fig. 1 shows that the fluid expressed from previously frozen cod fillets always contains more DNA than that from unfrozen fillets, whatever the rate of freezing. When freezing is very slow, however, the DNA may not be much above the ' unfrozen ' level. As freezing becomes more rapid, little change occurs until the time taken to cool from 0° to − 5° is less than 150 minutes, when a sudden large increase in DNA occurs. This seems to be caused by the change-over from intercellular to intracellular freezing, and the ice masses which first form within the cells are so large that they burst the sarcolemmas, liberating, among other things, nuclear material into the interstitial spaces, whence it is found in the expressible fluid. The phenomenon is also shown, though not so strikingly, by the nitrogen and solids in the expressible fluid. When the freezing-rate is increased further, the ice masses become smaller and cease to burst the cells, as shown by microscopic examination and by a corresponding drop in DNA.

An important aspect of this work is the light that it sheds on the conclusions of other workers, stated in the introductory section, about the ability or otherwise of the sarcolemmas to withstand the expansion due to freezing. Fig. 1 shows that the range of conditions under which maximal fibre rupture occurs is quite narrow, and it is therefore likely that some workers have missed it altogether when freezing tissue at different rates. This would explain, for instance, the conclusion of Koonz & Ramsbottom[3] that the muscle fibres were not ruptured by ice crystals, in spite of their using a wide range of freezing media.

Hiner, Madsen & Hankins[5] reported that, in cubes of beef muscle, fibre rupturing became more and more extensive as the freezing rate increased until, at the most rapid rate tried, nearly every fibre was burst. The conditions for the latter were obtained by freezing the meat in solid carbon dioxide, a technique which in the present work froze the fish rapidly enough for minimal rupture. However, the anomaly may be explained by the fact that the meat cubes were nearly twice as thick as the fish fillets used here, and also that a layer of ' tinplate ', of unspecified thickness, separated the meat from the solid carbon dioxide in Hiner, Madsen & Hankins' experiment. Disregarding, therefore, any difference that there may be between cattle and fish muscle, it seems probable that if these authors had frozen their meat samples more rapidly still, e.g. in carbon dioxide–alcohol, they would have found that the cells remained whole.

The further rise in DNA, nitrogen and solids when the fillets were frozen very rapidly indeed seems to be attributable to an entirely different cause. Examination of the sections of the frozen material (Fig. 2) does not yield much information. There are certainly large fissures in picture B (liquid oxygen) not obvious in the other ' frozen ' pictures, but these could have been caused during the sectioning.

A pointer to the probable explanations was found during the actual freezing. At the most rapid rate of all, the fillets were plunged into liquid oxygen contained in a Dewar flask. Immediately after their removal from the flask, when the thermocouple registered − 30°, it was noticed that the fillets were emitting faint cracking noises. On thawing, much of the muscle fell to pieces, and when the fillets were suspended in the expressing apparatus, several lumps of muscle dropped to the bottom of the can.

The mechanism is thought to be as follows: The outside layers of fillets placed in liquid oxygen or carbon dioxide–alcohol are frozen to a very hard shell before the inside part has cooled below freezing point. When the inside part commences to freeze, it expands and sets up great internal pressure. The outer shell, being rigid, is cracked by this pressure in many places, and the muscle fibres are cut across. Thus on thawing, cell contents are able to escape, and cause high DNA, nitrogen and solids values in the expressible fluid.

When fillets are frozen more slowly, there is time for heat transfer from the centre to the outside of the fillet, and a more uniform freezing occurs. Also, if there is any expansion from within, the outer surface will have a more yielding consistency and be able to take up the expansion without difficulty.

To summarize the effects of freezing, then, it may be said that fillets cooling from 0° to − 5° in about 130 min. suffer microscopic damage to individual fibres, whereas those cooling in

about 1–2 min. suffer macroscopic damage in the form of fissures across larger masses of tissue.

It should be emphasized that these phenomena apply only to fillets frozen from both sides. Different effects occur in fillets frozen from one side only, and are the subject of a future communication. The times of freezing shown above are maximum times, taking place in the centre of the thickest part of the fillet, as shown by a thermocouple. The outside layers freeze somewhat more rapidly, and this fact should be borne in mind whenever figures for 'rate of freezing' are quoted. One difficulty in comparing these results with other published work is that frequently the only data supplied on freezing rates are the temperatures of the surrounding air in which lumps of tissue, of unspecified size, are frozen.

The effects of cold storage are being investigated.

It may be wondered whether fish fillets frozen under the conditions causing maximum cell damage are any less desirable as articles of food. Further work is planned in order to answer this question, and also to find out whether fillets so frozen will smoke-cure after thawing to produce a satisfactory commercial article.

Acknowledgment

The work described in this paper was carried out as part of the programme of the Food Investigation Organization of the Department of Scientific and Industrial Research.

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Received 14 June, 1954

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THE DETECTION OF WASHED EGGS

By J. BROOKS and H. P. HALE

Several methods have been proposed for the detection of washed eggs. It is known that washing reduces the amount of potassium chloride on the shell and increases the electrical resistance of a drop of water subsequently placed on the shell. The method based on resistance has been examined in detail, and a search has been made for new methods. It was found that washing also tends to deplete the surface of the shell of magnesium, but the most promising method was based on the photochemical reduction of silver chloride on a test paper exposed to ultra-violet light. A sensitive and semi-quantitative form of chloride test is described.

Introduction

Long experience has shown that naturally clean eggs seldom rot during cold storage. Eggs with dirty shells do not keep so well, and the washing of such eggs before storage often increases the incidence of bacterial rotting still further. Also, it has been known[1, 2] since 1919 that washing favours the production of a type of rot—principally 'green rots' caused by *Pseudomonas* bacteria—that is difficult or impossible to detect by candling at the end of cold storage,

and consequently often reaches the consumer. Many papers have since been published on the subject.

As the farmer is usually paid less money for dirty eggs than for clean eggs, the dirty eggs are usually cleaned before they leave the farm. A recent survey[3] indicates that on the average about 30% of the eggs that are produced in the U.K. are dirty, and nearly all of them are cleaned by washing. The method most commonly employed is to allow the eggs to soak for an hour or so in water and to complete the cleaning if necessary by brushing or wiping. Observations made from 1948 onwards have shown[4] that the mean proportion of total rots (estimated by both candling and breaking eggs) was about 0·6% when clean, unwashed eggs were cold-stored for six months, and the proportion was 4% for the general run of clean eggs delivered by farmers to packing stations. It would seem from these values that on the average the proportion of washed eggs that rot during cold storage in this country may be as high as 11% [100(4 − 0·6)/30%]. Some forms of washing are more objectionable than others, and some have been reported as the cause of 20%, and occasionally of 50%, of rots.[5] As it is obviously preferable to store only eggs that are naturally clean, several methods have been proposed for the detection of washed eggs. This paper describes an examination of these methods and a search for new ones.

Existing methods

The application of protein stains

The outer surface of the shell is covered with a thin cuticle varying in thickness from egg to egg, and composed chiefly of mucin cells ;[6] the presence of the cuticle can be demonstrated by the application of protein stains. It has been stated several times that washing removes the cuticle, but Sharp[7] found that often this was not true, and concluded that staining was an unreliable test for a washed egg. Our own observations support this conclusion. Eggs were washed by various methods on one-half of their surface ; after drying, different stains and methods of fixation, some of them specific for mucin (thionin after fixation with mercuric chloride, toluidine B after fixation in a neutral formalin–saline solution, celestin B after fixation in a neutral formalin–saline solution, mucicarmine after fixation with mercuric chloride and acetic acid, and silver carbonate after fixation in Zenker's fluid, i.e. Müller's fluid and mercuric chloride), were applied to the washed and unwashed areas. It was often possible to detect a difference between the two areas on the same egg, but it was evident that some cuticles, presumably the thicker ones, were only partly removed by washing, and others were originally so thin or stained so lightly that a wrong conclusion could easily be drawn when the history of the egg was unknown. Abrasion will remove the cuticle completely, and Sharp[7] showed that staining could be used to detect scraped or sand-blasted eggs.

Exposure to ultra-violet light

The outer surface of the shell of a newly laid hen egg exhibits a red fluorescence in ultra-violet light, the intensity varying greatly from egg to egg. It has been stated[8] that washed eggs can be detected by exposing them to ultra-violet light, but we have been unable to confirm this claim. When newly laid eggs were washed by several methods on one-half of their surface and allowed to dry, a difference could usually be seen between the two areas on the same egg, but the difference was less than the natural variation between eggs. Moreover, the action of light can alter the fluorescence of the shell, and to a much greater extent than washing.

Several authors have believed that the fluorescence of the shell is a guide to the age of the egg, the fluorescence diminishing in intensity with time, and changing from red to blue. Such changes do occur, but Haitinger (according to Furreg[9]) and Baetslé & De Bruyker (according to Grossfeld[10]) maintained that they were caused by exposure to light, and had little to do with the actual age of the egg ; nevertheless, the first-mentioned view is still held in some quarters. Our own observations agree with those of the authors named. The fluorescence of newly laid eggs kept in the dark for several months did not change, whereas the exposure of similar eggs to daylight, and especially to direct sunlight or ultra-violet light, produced marked changes in unshaded areas within a few days or hours.

The shell occasionally acquires a stain, often from faeces, that is difficult to remove completely by washing. Some stains which are only visible on close inspection after the egg has been

washed are clearly revealed by ultra-violet light ; in some instances, the fluorescence of the shell is completely quenched. Scratches and abrasions can also be detected readily in ultra-violet light.[11]

The presence of soluble salts on the shell

Sharp[7] found that potassium chloride was normally present in small amounts on or in the surface of the shell, and that most of it was removed by washing. The tests for potassium and chloride described by Sharp[7] furnish a valuable means of identifying washed eggs. He also found that when unwashed eggs were stored at relative humidities exceeding about 80%, the potassium salt gradually disappeared from the surface, at a rate dependent on the temperature.

An ingenious method that depends on the presence of soluble salts on the shell has been devised by the New South Wales Egg Marketing Board, and has been used for several years, but no details of the method have been published. A drop of water is placed on the shell, two electrodes are immediately inserted into the drop, and the electrical conductivity with 6 v and 50 cycles a.c. is measured at once by means of a microammeter ; no trouble is experienced with polarization. When the conductivity is below a certain value the egg is deemed to have been washed. A more elaborate version of a similar method was used in the experiments described below.

The measurement of electrical resistance

The resistance of a drop of distilled water placed on the surface of an egg was found to change rapidly (Table I). For this reason, an arbitrary and standardized procedure was adopted, and the resistance was measured quickly by means of a Mullard mains unit supplying electricity at 1000 cycles a.c. and a Mullard bridge incorporating an electron-beam indicator as a null-point device. No trouble was experienced with polarization. Measurements were made at room temperature (15–20°).

Table I

The resistance of a drop of water placed on an unwashed shell

Time, min. ..	.. 0	1	2	3	4	5	9	12
Resistance, kΩ	.. 1300*	55	32	21	18	17	14	16

* Obtained from a drop placed on a slab of purified paraffin wax

The egg was placed lengthwise in a wire cradle mounted on a double-jointed arm attached to a vertical rack and pinion so that the egg could be moved about smoothly and rapidly. The electrodes were mounted on another vertical rack and pinion ; the form of electrodes and their position during a measurement is illustrated in the inset of Fig. 1. A drop of water (0·04 ml.) from a calibrated pipette was placed on the uppermost part of the shell ; after $2\frac{3}{4}$ minutes the two small electrodes of bare platinum wire (0·4 mm. in diameter) were immersed in the drop, and were moved up and down four times to mix the drop. The tips of the electrodes were brought lightly into contact with the shell (when the drop was suitably illuminated this could be done by sight), and the egg was then lowered a small and fixed distance by a simple mechanical device. Thus, when the resistance was measured to the nearest 1000 ohms (kΩ)—a matter of a few seconds—after the drop had been in contact

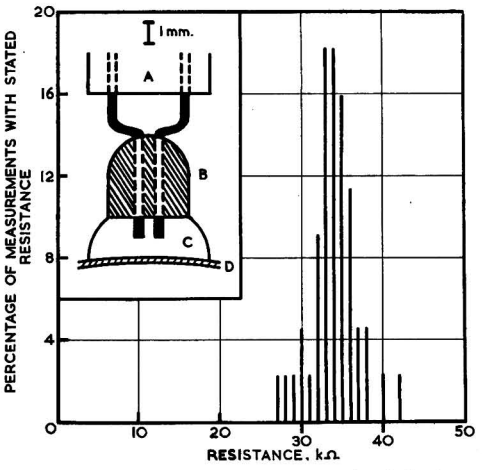

FIG. 1.—*Distribution of resistance on the shell of an unwashed egg*

Inset: electrodes immersed in drop on shell

A, Perspex; B, sealing wax; C, drop; D, shell

with the shell for 3 minutes, the distance between the electrode tips and the shell was always the same, and the electrodes were completely immersed. The electrodes were calibrated by measuring the resistance of solutions of potassium chloride, and were tested at intervals. No particular difficulty was experienced in preparing different sets of electrodes with the same ' cell constant '. The relation between concentration (C) of potassium chloride and resistance (R) for the electrodes was found to be:

KCl, %	0·001	0·002	0·005	0·0065	0·01
R, kΩ	200	100	42	33	21
CR	0·20	0·20	0·21	0·21	0·21

The distribution of resistance on the same shell and between shells

Unless otherwise stated, naturally clean eggs of known history were used, and measurements were made within a few days of laying. The distribution of resistance on the surface of an unwashed shell is shown in Fig. 1. The shell was marked out in four zones, and 11 drops were placed in turn at equidistant points on each zone. The results of the 44 measurements, together with similar ones from another egg, are summarized in Table II. Statistical analysis showed that there was no significant difference between zones on the same egg. Table II also summarizes the results obtained by measuring the resistance of single drops placed on 200 different eggs.

Table II

The distribution of resistance within and between shells

	Egg 1	Egg 2	Single measurements on 200 eggs
Mean resistance, kΩ	34·00 ± 0·41	32·21 ± 0·63	32·46 ± 0·59
Standard deviation	± 2·75	± 3·07	± 8·36
Range	27–42	27–38	11–70

The three means in Table II were similar, and in the neighbourhood of 32,000 Ω (equivalent to a 0·0066% solution of potassium chloride). Nevertheless, it can be shown that the difference between readings from place to place on a single egg is not large enough to account for the difference between single readings on different eggs. In other words, there is a variation both within and between eggs.

The effect of washing

Ninety-nine eggs were washed on one-half of their surface by rubbing for 3 minutes with a wad of wet cotton wool; the wad was dipped repeatedly in a large volume of distilled water. A single measurement of resistance was made on each area after the eggs had dried by drainage for 2 hours. The results are summarized in Table III.

Table III

The effect of washing on resistance

	Unwashed areas	Washed areas
Mean resistance, kΩ	31·70 ± 0·79	57·45 ± 1·59
Standard deviation	± 7·88	± 15·84
Sample size	Confidence limits (5%) for mean of sample readings, kΩ	
1	16·1–47·3	26·1–88·8
5	24·7–38·7	43·4–71·5
10	26·8–36·6	47·5–67·4
15	27·7–35·7	49·4–65·6
(99)	30·1–33·3	54·3–60·6

On the average, this type of washing increased the resistance 1·8 times. Nevertheless, the overlapping of the two confidence limits corresponding to samples of one egg (Table III) shows that a single measurement of resistance cannot be trusted to identify every unwashed or washed egg with certainty. The limits do not overlap, however, when the size of the sample is increased

to five or more. Hence, it would be possible 95 times out of 100 to decide whether a batch of eggs like the present one had been washed or not by making a single measurement on each egg of a random sample of five.

In practice, it is often not so important to know whether a given egg has been washed or not as to know whether a batch of eggs has been correctly described as unwashed. Such a decision can be made in the manner described above or, alternatively, by specifying a sufficiently high resistance as the border-line. For example, if 55,000 Ω were chosen, no unwashed surface in the present batch would be deemed to have been washed, and 50% of the washed surfaces would be identified correctly. It is probable that the method is applied in some such manner in Australia. If only a proportion of the eggs in a batch have been washed, the level of sampling must clearly be increased.

The effects of different methods and times of washing

Sixty eggs (twenty for each treatment) were washed on one-half of their surface either by rubbing for 3 minutes in the manner described above or by soaking in distilled water for 2 or 16 hours. A single measurement was made on each surface after the eggs had dried ; the mean values are set out in Table IV.

Table IV

The effect of time of washing on resistance

Time of washing, h.	Mean resistance, kΩ		r_2/r_1
	Unwashed surfaces (r_1)	Washed surfaces (r_2)	
0·05	35·9	65·6	1·86
2	37·5	71·8	1·97
16	36·8	131·0	3·60

The two types of washing most likely to be employed on farms—either rubbing with a wet cloth for a short period or soaking for 1–2 hours—increased the resistance to a comparable extent. The increase caused by soaking for 16 hours was so great that practically every washed surface could be detected with certainty by a single measurement, the confidence limits (5%) for a sample of one egg being 23·6–49·9 and 52·2–210 kΩ for unwashed and washed surfaces respectively.

It is evident that the action of water cannot be explained if the shell is considered to be a smooth impermeable surface carrying a deposit of readily soluble salts. The two shorter periods of washing in Table IV should have been ample to remove such a deposit completely, yet the change of resistance showed that the amount of soluble salts available had been only approximately halved. When, after drying, a washed surface was washed a second time, the resistance was again approximately doubled (the mean values for the unwashed, washed and twice-washed surfaces of 16 eggs were 24, 43 and 84 kΩ respectively). It seems probable, therefore, that water is able to extract salts from beneath the outer surface of the shell (the solubility of calcite, the main constituent of the shell, is negligible). The liquid portion of the egg plays no part in the movement of salts ; empty shells behaved in the same way as intact eggs.

The effect on resistance of soaking for a fixed time was increased by soaking in rapidly running water, and this fact probably explains why rubbing in water for 3 minutes was approximately equivalent to soaking in still water for 1–2 hours. Washing in tap-water (with a resistance of 11,000 Ω) in place of distilled water did not cause such a large increase of resistance, but the difference, as shown below, was small.

Mean resistances after soaking one-half of the shell of eight eggs in tap-water, and the other half in distilled water for 2 hours

Before washing	36,000 Ω
After washing in tap-water	64,000 ,,
After washing in distilled water	72,000 ,,

A number of dirty eggs were washed. When rubbing for 3 minutes with wet cotton wool or soaking for 1–2 hours was sufficient to clean them, the results were similar to those obtained

when clean eggs were washed by the same method. When more vigorous methods such as brushing had to be used, the resistance, as might be expected, was increased still further.

The relation between electrical resistance and available potassium

In the method described by Sharp,[7] a drop of water that has been in contact with the shell for 5 minutes is transferred to a glass slide. A drop of sodium cobaltinitrite reagent is added, and a stiff platinum wire is used to mix the two drops and to scratch the glass slide in order to aid precipitation. The drop, illuminated horizontally, is then viewed through a microscope. Sharp tested for chloride in a similar manner, using silver nitrate in place of sodium cobaltinitrite. We have applied the potassium test to drops removed from the shell of 20 unwashed eggs immediately after the resistance of the drop had been measured; 80 tests were made in all. The resistances, classified according to the extent of precipitation, are compared in Table V with those of solutions of potassium chloride that gave comparable amounts of precipitate.

Table V

Comparison of the behaviour of potassium chloride solutions and drops from eggs

	KCl solutions		Eggs		
Extent of pptn.	Concn., %	Resistance, kΩ	No. of readings	Resistance, kΩ Mean	Range
Detectable	0·0065	33	32	35	24–49
Barely detectable	0·005	41	48	42	33–51
Not detectable	0·0035	59			

Sharp[7] concluded that after 5 minutes' contact with an unwashed egg a drop contained approximately 0·005% of KCl, and the results given in Table V suggest a similar order of magnitude. Further, in spite of the difficulties of detecting minute amounts of precipitate, the correspondence between the two sets of resistances in the Table suggest that the electrolytes in the drop consist principally of potassium salts.

The advantage of Sharp's potassium test is that the limit of identification of potassium chloride (about 1½ μg. of KCl per drop) is usually overstepped if the egg has been washed, and consequently a negative reaction is obtained instead of a less intense reaction. Twenty eggs that had been washed by soaking for 16 hours gave a negative reaction in every instance, but the change of resistance caused by short periods of washing suggests that the variation within and between eggs would lead to some incorrect judgments if the amount of potassium in the drop is inversely proportional to the resistance. A comparison of three methods of detection, including the potassium test, is described below.

The effect of time and humidity of storage

The observation of Sharp[7] that, under certain conditions, potassium salts tended to disappear from the surface of the shell, was confirmed, and this movement was found to be accompanied by changes in electrical resistance. Four batches of 10 eggs were washed on one-half of their surface by soaking in distilled water for an hour. The batches were stored in desiccators at 20° above saturated solutions, containing some of the solid phase, of $K_2Cr_2O_7$, KCl, $NaNO_3$ and $K_2CO_3,2H_2O$ in order to maintain relative humidities of 98, 84, 74 and 43% respectively.[12] Single measurements of resistance were made on each surface at intervals, and the mean values are set out in Table VI; 480 measurements were made in all. An analysis of variance for each humidity confirmed the significance of the gradual increase of resistance of unwashed surfaces at relative humidities of 74% (1% level of significance), 84% and 98% (0·1% level of significance at both humidities). Some of the smaller changes shown by the washed surfaces were also significant. Changes occurring at 43% r.h. were not significant.

Sharp[7] suggested that the disappearance of potassium chloride might be caused by the uptake of water by the salt—and the diffusion of the solution into the interior of the egg—when the humidity of the atmosphere exceeded that of a saturated solution of potassium chloride at the same temperature. Table VI shows that a movement of salts can take place at a still lower humidity (74% r.h.), but this does not invalidate Sharp's suggestion. As will be seen, soluble

Table VI

The effect of time and humidity on electrical resistance at 20°

Time, days	Resistance, kΩ			
	Unwashed surface	Washed surface	Unwashed surface	Washed surface
	98% r.h.		84% r.h.	
0	26	53	26	49
2	28	47	25	46
4	31	43	27	42
7	37	51	29	49
11	41	52	33	49
15	41	57	39	53
	74% r.h.		43% r.h.	
0	28	49	27	50
2	31	49	28	46
4	30	42	27	47
7	31	41	28	41
11	34	42	29	44
15	36	40	28	40

salts other than potassium chloride are present on or in the shell, and the drying-up point of the solution might well be below 84% r.h. The salts, however, do not diffuse into the liquid portion of the egg since empty shells kept at different humidities behaved in the same way as intact eggs. Nor does it seem likely that the capillary structure of the shell is involved. It is possible that under moist conditions there is an actual incorporation of salts into the lattice of the calcite grains of the shell. It has been suggested for bone that the small amounts of sodium present may share a carbonate valence with calcium.[13, 14]

In the U.K., at least, the humidity is seldom high enough to alter the resistance appreciably (except with cold-stored eggs[7]). A more important factor than humidity in this respect is airborne contamination. The resistance of eggs exposed to the air of the laboratory decreased with time even though the humidity was low, and the same thing happened more slowly in the air of the town. These changes did not interfere with the potassium test up to the eighth day; that they were caused by contamination, presumably by traces of acid vapour, is shown by the results brought together in Table VII. In this experiment, eggs were kept uncovered in the laboratory (average r.h. 45%) and others were kept in a desiccator through which washed laboratory air of 43% r.h. was passed continuously. The air was washed and humidified by forcing it through a sintered-glass septum mounted at the bottom of a cylinder containing a saturated solution of potassium carbonate. In purified air, the unwashed shells did not alter appreciably, and the washed shells only slightly; in laboratory air, there was a considerable and approximately equivalent accumulation of electrolytes on both washed and unwashed surfaces.

Table VII

The effect of airborne contamination on resistance

Time, days	Resistance, kΩ			
	Laboratory air		Purified air	
	Unwashed eggs	Washed* eggs	Unwashed eggs	Washed* eggs
0	38	155	36	108
2	30	66	37	108
5	28	53	39	118
8	27	47	37	93

* Soaked in distilled water for 16 hours

Alternative methods

The solutes on the shell

It was thought that other tests might be found if more were known about the solutes on the shell. Twenty unwashed eggs were each sprayed with 2·5 ml. of water, and the process was

repeated 3 minutes later ; the eggs were allowed to drain for a further minute. The liquid was centrifuged, dried and the residue was dissolved in a small volume of water. A number of such experiments gave consistent results ; on the average, each egg yielded 1·1 mg. of soluble material in which potassium and chloride were present in approximately equivalent amounts (atomic ratio 1 : 1·06) to the extent, together, of 47%. Potassium and chloride were estimated by the methods of Kelley *et al.*[15] and Kolthoff & Stenger[16] respectively. Spot-tests and inorganic paper-chromatography showed that the solution also contained carbonate (or bicarbonate) and magnesium, but either no aluminium, iron and phosphate or only insignificant traces. Calcium and magnesium were estimated by titration with 0·025N-disodium ethylenediaminetetra-acetate ;[17, 18] the amount of calcium present was insignificant, but magnesium, if present in the form of carbonate, accounted for 20% of the dried residue. The solution itself would contain about 0·004% of potassium chloride if it were diluted until its resistance was 32,000 Ω, which is the mean resistance of a drop after 3 minutes' contact with an unwashed shell. The approximate composition of the solutions and their electrical resistances indicated that roughly 85% of the dissolved material consisted of salts.

It was found that the majority of washed and unwashed eggs could be correctly identified by testing for magnesium. The most promising method, however, proved to be a chloride test based on the photochemical reduction of silver chloride on exposure of a test paper to ultra-violet light.[19] As far as is known, the sensitive and semi-quantitative form of the chloride test described below has not been reported before, and it might prove useful for other purposes.

The paper used in all the tests was either washed Whatman No. 54 or washed Whatman Drop Reaction Paper No. 120. A stock of washed paper was prepared by soaking it in 2N-acetic acid for several days, washing it free from acid and acetates with distilled water, and drying.[20] In the tests, a drop of distilled water (0·04 ml.) was placed on an egg. After 3 minutes' contact, a micro-drop (0·01 ml.) was removed by means of a glass capillary (the diameter of the capillary and the length of the liquid column being approximately the same in each instance). The main drop was stirred with a thin glass rod immediately before sampling. The micro-drop was transferred to the paper by touching the paper with the tip of the loaded capillary.

Chloride test.—Sheets of Drop Reaction Paper No. 120 were dipped in 0·02N-silver nitrate solution and dried at 40° in the dark ; stocks of the impregnated paper were also kept in the dark. The test micro-drop was placed on the paper, and a micro-drop of 0·02N-silver nitrate solution was added to the centre of the moist circle. The paper was placed three inches below the bulb of an ultra-violet lamp (Osram MBW/V—a 125-w mercury discharge unit enclosed in a bulb of Woods glass) and kept there for five minutes. This exposure developed the spot and helped to dry the paper. When silver nitrate solution was applied twice in the manner described above, the reduced silver was confined to a small spot at the centre of the original area ; a micro-drop of 0·005% potassium chloride solution gave a dark-grey spot about 2 mm. in diameter. When the preliminary impregnation of the paper with silver nitrate solution was omitted or, alternatively, when impregnated paper was used and no silver nitrate solution was added after the test drop, the paper, when chloride was present, either became faintly brown over the whole of the circle originally moistened, or alternatively the central spot was fainter and bluish in colour.

In nine cases out of ten, the spots given by washed and unwashed eggs could be distinguished easily because both the depth of colour and the diameter of the spots were very different (cf. Table X). The efficiency of the test, however, was increased by measuring the absorption of light by the spots by means of an E.E.L. densitometer. The diameter of the aperture transmitting filtered light (Ilford Tri-colour Red filter No. 204) through the paper to the photoelectric cell was 2 mm. The galvanometer reading (on a logarithmic scale) was set at zero when a part of the paper untouched by the drops was inserted in the instrument, the paper was then moved until the spot came into the correct position.

Table VIII contains the results obtained with micro-drops of potassium chloride solutions and micro-drops of distilled water treated in the same manner (control spots). The values in the fourth column of the Table show that the absorption of the test spots corrected for the absorption of the control spots, $(b - c)$, was roughly proportional to the amount of chloride present over a fair range. The test was very sensitive, giving a recognizable reaction with a micro-drop of 0·0005% potassium chloride solution (0·025 μg. of Cl). Similar measurements were made with

Table VIII

Relation between concentration of potassium chloride and light absorption of spots

Concn. of KCl, %	Reading on test spot	Reading on control spot	$\frac{b-c}{a}$	Diameter of spot, mm.
a	*b*	*c*		
0·01	1·00	0·04	96	2·9
0·0075	0·84	0·06	104	2·9
0·005	0·65	0·04	122	2·1
0·0025	0·45	0·01	176	1·8
0·001	0·17	0·01	160	1·3
0·00075	0·14	0·04	133	1·2
0·0005	0·11	0·05	120	1·1

paper impregnated with 0·02N-silver nitrate solution containing 0·003% of phenosafranine (an adsorption indicator sensitive to chloride) ; the presence of the dye had little or no effect on the sensitivity of the test, but some observers preferred the coloured paper when the spots had to be judged by the eye.

Magnesium test.—The test micro-drop was placed on Whatman No. 54 filter paper, and a micro-drop of freshly prepared aluminon reagent (0·3% of aluminon and 1% of ammonium acetate, in water) was added to the centre of the moistened circle. The paper was then placed over ammonia solution (sp. gr. 0·88) in a closed vessel. When sufficient magnesium was present in the drop, a reddish-violet ring appeared near the circumference of the spot. The colour given by most of the other cations tested faded over the ammonia solution, but the coloration from magnesium was stable (although it faded in air). The micro-drops from unwashed eggs gave a positive reaction, those from washed eggs, a fainter reaction or a negative one. The method was not particularly accurate or convenient because of the faintness of the colours and the instability of the reagent, and its use was abandoned. Nevertheless, approximately 75% of washed and unwashed eggs could be identified correctly by this means. Tests for magnesium with other reagents in place of aluminon were less successful.

Comparison of different methods of detection

Fifty eggs out of a hundred were washed by immersing them completely in distilled water for 1 hour, and the tests were commenced next day. The results of single measurements of resistance on the hundred eggs are summarized in Table IX ; they resemble closely those set out in Table III where the eggs were washed by rubbing with wet cotton wool for 3 minutes.

Table IX

The effect of washing on resistance

	Resistance, kΩ	
	Unwashed eggs	Washed eggs
Mean resistance	31·52 ± 1·46	63·32 ± 2·56
Standard deviation	± 10·30	± 18·09

Sample size	Confidence limits (5%) for mean of sample readings, kΩ	
1	10·8–52·2	27·0–99·7
5	22·3–40·8	47·1–79·6

As before, the confidence limits for samples of one egg overlapped, but those for samples of five eggs did not. As an illustration of this, the following means (kΩ) were obtained when the readings on each type of egg were arranged in ten random samples of five. It will be seen that all the values fall within the appropriate confidence limits.

Unwashed eggs	35	31	31	32	34	37	31	26	30	30
Washed eggs	68	61	68	64	68	66	65	59	50	64

If identification were based on a border-line resistance, a choice of 55,000 Ω would have identified correctly 96% of the unwashed eggs and 64% of the washed eggs. The corresponding values for

a border-line of 45,000 Ω (approximately midway between the two means in Table IX) are 88 and 86% respectively.

With the potassium test, 86% of the unwashed eggs and 78% of the washed eggs were identified correctly on the basis of a positive and negative reaction respectively. Sharp[7] rightly states that both experience and concentration are required for this test because of the minute amounts of precipitate involved, and a better score would probably have been obtained with more practice. Nevertheless, it was interesting that both the potassium test and a border-line of 45,000 Ω gave similar results, and that several of the same eggs were identified wrongly by both means.

With the chloride test, and judging the silver spots by eye, 89% of all the eggs were identified correctly, and judgment was withheld in the remaining instances (4% of unwashed eggs and 7% of washed eggs). The densitometer readings are summarized in Table X; as in Table VIII, the values give the absorption of the test spots corrected for the absorption of the control spots, i.e. $(b - c)$. The mean diameter of the spots was 2·8 and 1·5 mm. for unwashed and washed eggs respectively.

Table X

Densitometer readings on spots from unwashed and washed eggs $(b - c)$

	Unwashed eggs	Washed eggs
Mean	0·554 ± 0·0195	0·149 ± 0·0122
Standard deviation	± 0·138	± 0·086

Sample size	Confidence limits (5%) for mean of sample readings	
1	0·277–0·831	0–0·323
5	0·430–0·678	0·072–0·227

There was only a small overlap of the two confidence limits for a sample of one egg, and an examination of the individual values showed that a choice of a relative absorption, $(b - c)$, of 0·3 would identify 96% of both washed and unwashed eggs correctly.

If the values of $(b - c)$ can be translated into concentrations by means of the results in Table VIII, it follows that the drops from unwashed eggs contained on the average about 0·002% of chloride ions (or about 0·004% of potassium chloride), and those from washed eggs, 0·0005% of chloride ions; the first value is in good agreement with that suggested by the chemical analyses for chloride previously described. Washing apparently reduced the amount of available chloride by three-quarters although, judging by the change in resistance, it only halved the total amount of soluble salts available. It seems probable, therefore, that the unwashed shell carries a local excess of chloride on or near its surface; the salts extracted by a drop from a washed egg are presumably more representative of the composition and permeability of the shell as a whole.

The effect of time and humidity of storage on the behaviour of the chloride test was not studied in detail, but its efficiency was not impaired when eggs were kept up to 16 days at ordinary temperatures and humidities either inside or outside the laboratory. Prolonged exposure to laboratory air, however, did increase the value of $(b - c)$; after 45 days the mean value for 25 washed eggs was 0·23, and only 60% of the eggs could be identified correctly by a border-line value of 0·3. By this time, the mean resistance had sunk from about 60,000 to 20,000 Ω so that only a small proportion of the acquired contamination could have been chloride. The mean resistance of the accompanying 25 unwashed eggs had decreased from about 30,000 to 15,000 Ω during the same period; all of these eggs, as would be expected, were identified correctly by the chloride test.

Discussion

One of the objections to the washing of dirty eggs on farms is that subsequently there is no simple means of removing the washed eggs if it is desired to store or export only eggs that have not been washed. Separation would be practicable if washed eggs could be detected by their appearance in ultra-violet light, but none of the tests that are effective could be used for this purpose because the number of eggs involved is too large, and the labour too great. Nevertheless, tests that will detect washed eggs are required when, as in Eire, the washing of eggs on farms

is forbidden or when, as in Australia, poultry farmers are required to deliver washed eggs to packing stations in separate and labelled containers.

The chloride test described above seems to possess some advantages over the other methods that have been proposed. It is reasonably accurate, and the results can be measured quantitatively. As a number of spots can be developed on the same sheet of paper, the test is fairly rapid if it is carried out by two persons, and drops are placed on the eggs and sampled in a staggered fashion. So long as the eggs have not been exposed to too much airborne contamination—and in practice this would be most unlikely—resistance measurements will show whether washed eggs are present in a batch, although they will not show precisely how many eggs have been washed. The potassium test in practised hands may be as accurate as the chloride test, but it requires experience and concentration.

The chief solutes removed from the surface of the shell by water seem to be potassium, magnesium, chloride and carbonate. The solution may also contain a little citrate since this anion is also present in the shell in small amounts.[21] The shell as a whole apparently contains little chloride; the chief anions, in abruptly decreasing proportions, are carbonate and phosphate, and the cations, calcium, magnesium, sodium and potassium. The known solubilities of calcium and magnesium carbonates help to explain the presence of carbonate and the relative proportions of the two cations in the washing water. Magnesium carbonate is relatively soluble, and the amount contained in a drop after three minutes' contact with the shell is much less than would be found in a saturated solution. The deficit may be partly caused by the short time of contact, but the fact that successive washings steadily increase the electrical resistance is an indication that washing tends to deplete the surface of the shell of magnesium carbonate. It is interesting that the amount of magnesium dissolved in the white of the egg is also much less than would be expected[22] from the solubility of magnesium carbonate and its presence in the shell. It seems probable that the soluble salts in the interior of the shell are not readily accessible to water.

Acknowledgments

The authors are pleased to express their thanks to Dr. J. Wishart, in whose laboratory the statistical computations were carried out, and to the New South Wales Egg Marketing Board for permission to refer to the conductivity method developed by the Board. Mr. N. R. King assisted in the experimental work described in this paper. The work was carried out as part of the programme of the Food Investigation Organization of the Department of Scientific and Industrial Research.

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Received 26 July, 1954

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THE COMPONENT ACIDS AND GLYCERIDES OF INDIAN CROCODILE (*GAVIALIS GANGETICUS*) FAT

By S. P. PATHAK and G. D. PANDE

The fatty acid composition of a crocodile depot-fat, determined by the usual ester-fractionation method, with an electrically heated and packed column, is recorded. The glyceride structure was studied by crystallization of the neutral fat from acetone at room temperature and lower (— 18°). The composition of each of the three fractions, thus obtained, was studied separately by the fractionation method, and the final glyceride composition computed therefrom is also given. The component saturated acids are palmitic (25·8%), stearic (8·7%), myristic (4·2%) and lauric (0·2%), and unsaturated acids are C_{14} (2·0%), C_{16} (11·6%), C_{18} (35·5%), C_{20} (10·0%) and minor proportions of C_{22} (2·0%). The component glycerides are : (I) fully saturated 7·5%, (II) mono-unsaturated-disaturated 27·7%, (III) diunsaturated-monosaturated 64·8%.

Results

Adipose tissues (1300 g.) were procured from a crocodile caught from the Ganges at Assi, Banaras. It was first rendered with water, when a layer of crude fat separated. This was skimmed off and the remaining fat was recovered from the residue with anhydrous acetone. The fat obtained from the first and second extractions was combined and treated with light petroleum, in which the clear fat dissolved. The light-petroleum solution was filtered and the solvent removed. From the fat thus obtained (1000 g.) a large quantity (about 500 g.) was kept in ten times its volume of acetone at 0° for the removal of phosphatides. The phosphatide-free fat was next dissolved in ether and neutralized with 10% potassium hydroxide solution. The ethereal layer was washed free of soap and the neutral glyceride (470 g., I.V. 72·6) was recovered.

Determination of component acids

The mixed fatty acids obtained from a portion of neutral fat were separated into two groups of acids by the lead salt–alcohol separation method (chart I).

Crystallization chart I

Group	Description	Weight		I.V.
		g.	%	
A	Lead salt alcohol-insoluble	67·0	35·1	5·5
B	Lead salt alcohol-soluble	122·0	64·9	141·1

Each of these groups was separately converted into methyl esters, which were fractionally distilled. The ester-fractionation results for the methyl esters of both the groups are summarized in Table I.

From the results in Table I and crystallization chart I the composition of mixed acids in the fat was calculated by the method given by Hilditch[1] and is presented in Table II.

Determination of component glycerides of crocodile depot-fat

A portion of the neutral fat (260 g., I.V. 72·6) was crystallized from acetone (10 c.c. per g.) at — 5° when 46·0 g. of glycerides (I.V. 54·3) separated out. The soluble portion (214 g., I.V. 76·5) was again crystallized from acetone (10 c.c. per g.) at — 15° and 22 g. of insoluble glycerides (I.V. 14·5) and 192 g. of soluble glycerides (I.V. 83·5) were obtained. The soluble portion was further crystallized from acetone (5 c.c. per g.) at — 18°, and 11 g. of insoluble glycerides (I.V. 5·2) and 181 g. of soluble glycerides (I.V. 87·2) were obtained ; this last soluble portion formed fraction C (chart II). The insoluble portion (46 g., I.V. 54·3) from the crystallization at — 5° was further crystallized from acetone (5 c.c. per g.) at — 18°, and gave 16 g. of insoluble glycerides (I.V. 37·5) and 30 g. of soluble glycerides (I.V. 65·5). From these portions the 16-g. fraction (I.V. 37·5) and the 22-g. fraction (I.V. 14·5) were combined to give fraction A (38 g., I.V. 22·5) ; fraction B (41 g., I.V. 47·2) was obtained by combining the 30-g. fraction (I.V. 65·5) with the 11-g. fraction (I.V. 5·2) (see chart II).

Fractions A, B and C were saponified in the usual manner, unsaponifiable matter was

Table I

Fractionation results for methyl esters of the acids of crocodile depot-fat

No.	Wt., g.	Saponification equiv.	I.V.
Methyl esters of lead salt-insoluble acids (A)			
A1	3·34	246·5	0·2
A2	3·57	253·6	1·5
A3	3·71	266·9	1·5
A4	5·48	267·1	1·6
A5	4·65	267·1	1·6
A6	4·86	270·0	1·6
A7	4·97	273·2	1·6
A8	4·57	276·4	2·9
A9	4·68	276·6	3·5
A10	4·59	278·3	4·4
A11	5·60	282·8	9·7
A12	3·82	294·2*	21·7
Methyl esters of lead salt-soluble acids (B)			
B1	2·54	238·5	58·5
B2	3·11	264·8	82·2
B3	5·79	276·7	94·6
B4	4·57	282·9	102·3
B5	5·33	285·6	105·2
B6	5·07	287·4	108·1
B7	5·58	294·6	111·2
B8	5·05	298·6	113·2
B9	4·86	300·6	118·4
B10	4·90	302·0	171·2
B11	4·62	309·8	233·0
B12	3·29	338·7*	235·2

* Equivalents of esters (freed from unsaponifiable matter): A12, 280; B12, 318·5

Table II

Acids	A (35·1%)	B (64·9%)	Total	Excluding unsaponifiables % (wt.)	Excluding unsaponifiables % (mol.)
Lauric		0·22	0·22	0·22	0·3
Myristic	3·05	1·21	4·26	4·25	5·0
Palmitic	24·20	1·64	25·84	25·83	27·3
Stearic	6·84	1·83	8·67	8·67	8·9
Unsaturated					
C_{14}	0·02	1·97	1·99	1·98	2·3
C_{16}	0·62	10·96	11·58	11·57	12·4
C_{18}	0·36	34·98	35·34	35·46	33·3
C_{20}		10·02	10·02	10·02	8·9
C_{22}		2·0	2·0	2·00	1·6
Unsaponifiable	0·01	0·07	0·08		
Mean unsaturation of					
C_{14}	− 2·0	− 2·0	− 2·0		
C_{16}	− 2·0	− 2·0	− 2·0		
C_{18}	− 2·0	− 3·0	− 3·0		
C_{20}		− 4·8	− 4·8		
C_{22}		− 8·0	− 8·0		

removed and fatty acids were recovered. Fatty acids from C were subjected to the lithium salt–acetone separation, and the insoluble portion from this was subjected to the lead salt–alcohol treatment, to give the fatty acids CA, CB and CC respectively. Fractions A and B were also subjected to lead salt–alcohol separation and the respective fatty acids recovered (fractions AA, AB, BA and BB). All these fatty acid fractions (AA, AB, BA, BB, CA, CB and CC) were converted into methyl esters and fractionated through an electrically heated and packed column.

The ester-fractionation results of all these fractions are not given but the component acids of each glyceride fraction are summarized in Table III, the totals of which show good

general agreement with those obtained by analysis of the mixed acids of the whole fat (Table II). Differences of 0·08–2·6 unit per cent. will be noticed between the corresponding values in Table II and Table III in the major component groups.

Crystallization chart II

Crocodile depot-fat fractions from aceione

Fraction	Description	Wt., g.	I.V.
A	Insoluble at − 15° (5 × A and 10 × A)	38·0	22·5
B	Soluble at − 15° (5 × A)		
	Insoluble at − 18° (5 × A)	41·0	47·2
C	Soluble at − 18° (5 × A)	181·0	87·2

Lead salt–alcohol separation

Weight, g.	14	10	16·0	22	45·7	77·3	24
Weight, %	58·3	41·7	42·1	57·9	31·1	52·6	16·3
I.V.	5·0	46·1	3·7	61·6	6·5	100·5	170·0
Fraction	AA	AB	BA	BB	CA	CB	CC

Note : 5 × A indicates 5 c.c. of acetone/g.
10 × A indicates 10 c.c. of acetone/g.

AA, BA and CA : lead salt-alcohol-insoluble fatty acids
AB, BB and CB : ,, ,, ,, soluble fatty acids
CC : lithium salt-acetone-soluble fatty acids

Possible combinations of these groups of acids to produce different types of mixed glycerides are then calculated on the theory of computation given by Hilditch *et al.*[1]

A separate determination of fully saturated glycerides by the permanganate oxidation

Table III

Crocodile depot-fat fractions from acetone and their component acids (increments % mol.)

Component acids	A	B	C	Total
Lauric	0·2	—	—	0·2
Myristic	1·5	1·9	3·2	6·6
Palmitic	7·2	5·7	16·3	29·2
Stearic	3·6	2·8	5·1	11·5
Unsaturated				
C_{14}	Trace	0·2	1·2	1·4
C_{16}	1·1	1·6	8·4	11·1
C_{18}	1·4	3·9	27·8	33·1
C_{20}	—	—	6·1	6·1
C_{22}	—	—	0·8	0·8
Total acids	15·0	16·1	68·9	100·0
	Mean unsaturation of acids			
Unsaturated				
C_{14}	(− 2·0)	(− 2·0)	(− 2·0)	(− 2·0)
C_{16}	(− 2·0)	(− 2·0)	(− 2·0)	(− 2·0)
C_{18}	(− 2·0)	(− 2·0)	(− 2·12)	(− 2·12)
C_{20}	—	—	(− 4·06)	(− 4·06)
C_{22}	—	—	(− 10·0)	(− 10·0)

method was carried out as described by Hilditch & Lea,[2] the neutral fully saturated glycerides being recovered by the method of Steger & Van Loon ;[3] 8% of fully saturated glyceride (I.V. nil, acid value nil) was obtained.

Discussion

Fatty acid composition

The component saturated fatty acids of the fat are lauric 0·2%, myristic 4·2%, palmitic 25·8% and stearic 8·7%, making a total of 38·9%, and the unsaturated acids are C_{14} 2·0%, C_{16} 11·6%, C_{18} 35·5%, C_{20} 10·0% and C_{22} 2·0%, forming 61·1% of the total acids, among which C_{18} (35·5%) predominates.

The depot fat of crocodile, a large amphibian saurian reptile, can be compared with depot fats of other amphibians. Table V gives the fatty acid composition of a few depot fats from the frog, lizard and turtle families. All these results show that the unsaturated C_{16}–C_{20}–C_{22} acids are present in much smaller quantities than in fish depot-fats; the C_{18} acid forms the biggest group. The saturated acids of these fats are much more similar to those of typical fish than are the unsaturated acids and are C_{14} 4–10%, C_{16} 11–29% and C_{18} 3–10% in frog, lizard, Greek tortoise and green turtle respectively.

The similarity between the total saturated acid content of crocodile fat and other amphibian fats, in particular that of the lizard (Table V, column 4), is also found for the C_{16} and C_{18} unsaturated acids. The degree of unsaturation is also closely similar.

Table IV

Component fatty acids, % (wt.), of amphibian and reptile depot-fats

Common name	Frog	Lizard (1)	Lizard (2)	Greek tortoise	Green turtle	Green turtle	Crocodile (Gharial)
Zoological name	*Ranatemporaria*	*Varanus salvator*	*Varanus salvator*	*Testudo graeca*	*Chelone mydas*	*Chelone mydas*	*Gavialis gangeticus*
Observer	Klenk[4a]	Klenk *et al.*[4b]	Hilditch & Paul[8]	Klenk *et al.*[4b]	Green & Hilditch[5]	Ogata & Minato[9]	Present work
Lauric	—	—	—	—	13·3	14·2	0·2
Myristic	4	4	4	1	10·6	7·2	4·2
Palmitic	11	18	29	14	17·0	15·2	25·8
Stearic	3	7	10	4	4·1	6·8	8·7
Unsaturated							
C_{14}	—	—	—	—	1·3 (− 2 H)	2·6 (− 2 H)	2·0 (− 2 H)
C_{16}	15 (− 2 H)	10 (− 2 H)	12 (− 2 H)	9 (− 2 H)	7·8 (− 2 H)	10·9 (− 2 H)	11·6 (− 2 H)
C_{18}	52 (approx. − 2·5 H)	56 (− 2·4 H)	40 (− 2·7 H)	65 (− 2·4 H)	39·6 (− 2·2 H)	39·4 (− 2 H)	35·5 (− 3·0 H)
C_{20-22}	15 (approx. − 6 H)	5 (− 5·5 H)	5 (− 5·5 H)	7 (approx. − 4 H)	6·1 (− 6·3 H)	small (− ? H)	12·0 (− 5·5 H)

The component acids of the crocodile fat with those of the other amphibians form a link intermediate in almost all respects between those of the aquatic and the land animals, which is seen in Table IV. The unsaturated (C_{16}–C_{20}–C_{22}) acid components are present in much smaller proportions than in fish depot-fats and the unsaturated C_{18} acids are predominant. The saturated acids are more reminiscent of typical fish fats than are the unsaturated components. In the depot fats of larger animals, the content of hexadecenoic and unsaturated C_{16}, C_{20} and C_{22} acids is very small. The proportion of palmitic acid is characteristic of land-animal depot-fats[4] and is seen in frog and lizard fats. Frog fat seems to be nearer in type to aquatic than to land-animal fat, and the others are intermediate in composition.

Component glycerides

The study of glycerides of the fat by the acetone crystallization procedure as suggested by Hilditch[1] was undertaken so that the few data on glycerides of fats from amphibian animals could be increased. The component glycerides of the fat are: fully saturated glyceride 7·5%, disaturated-mono-unsaturated 27·7% and monosaturated-diunsaturated 64·8% (Table V). The fully saturated glycerides were also determined[2] and found to be 8%, a value close to that obtained by the systematic acetone separation of nearly trisaturated glycerides. A slight difference of 0·53% is either negligible or this quantity may have been included in the acetone fraction B.

From the literature the only other amphibian fat studied is that of green turtle (*Chelone mydas*), by Green & Hilditch;[5] the percentage of fully saturated glyceride component in this case is 9 (crocodile 7·5). The percentages of saturated acids in crocodile and green turtle are 48% and 50% respectively. The significant difference in the component glycerides of the crocodile and green turtle fats is that the former fat does not contain triunsaturated glycerides, whereas the latter is reported to contain 9% (mol.) of tri-C_{18}-glycerides.

The glyceride structure of the crocodile fat, like that of the green turtle, appears to be more similar to that of the fat of marine animals than to that of land animals, in other words, is intermediate between that of marine and land animals. The glyceride structure of the crocodile fat conforms to the highly mixed type, as has been observed in the analysis of herring

Table V

Crocodile depot-fat : glycerides

(I.V. 72·6, acid value 0·0, free fatty acids 0·0% as oleic)

Fractions	A	B	C	Total
Weight, g.	38·0	41·0	181·0	260·0
Iodine value	22·5	47·2	83·2	
Sap. equiv.	274·1	275·2	284·2	
Glycerides, % (wt.)	14·6	15·8	69·6	
Glycerides, % (mol.)	15·0	16·1	68·9	
Component acid groups (increment % mol.)				
Lauric and myristic	1·7	1·9	3·2	6·8
Palmitic and stearic	10·8	8·5	21·4	40·7
Unsaturated C_{14} and C_{16}	1·1	1·8	9·6	12·5
Unsaturated C_{18}	1·4	3·9	27·8	33·1
Unsaturated C_{20} and C_{22}	—	—	6·9	6·9
Glyceride, % (mol.)	15·0	16·1	68·9	100·0
Component glyceride groups (increment % mol.)				
(*a*) Fully saturated	7·5	—	—	7·5
(*b*) Mono-unsaturated-disaturated	7·5	15·2	5·0	27·7
(*c*) Diunsaturated-monosaturated	—	0·9	63·9	64·8
Possible component glycerides (increment % mol.)				
(*a*) Fully saturated (7·5)				
Tripalmitin	2·5	—	—	2·5
Dipalmitostearin	2·2	—	—	2·2
Palmitodistearin	2·8	—	—	2·8
(*b*) Mono-unsaturated-disaturated (27·7%)				
Tetradecenomyristopalmitin	—	0·6	—	0·6
Hexadecenolauromyristin	0·6	—	—	0·6
Hexadecenomyristopalmitin	2·7	4·7	—	7·4
C_{18}-myristopalmitin	1·0	0·5	—	1·5
C_{18}-palmitostearin	3·2	8·3	—	11·5
C_{18}-dipalmitin	—	1·1	5·0	6·1
(*c*) Diunsaturated-monosaturated (64·8%)				
Tetradecenohexadecenomyristin	—	—	3·6	3·6
Hexadeceno-C_{18}-myristin	—	—	6·0	6·0
Hexadeceno-C_{18}-palmitin	—	—	15·5	15·5
C_{18}-gadoleopalmitin	—	—	0·6	0·6
C_{18}-gadoleostearin	—	—	15·3	15·3
Gadoleo-C_{22}-palmitin	—	—	2·4	2·4
Di-C_{18}-palmitin	—	0·9	20·5	21·4

fat by Bjarnason & Meara[6] and whale fat by Hilditch & Maddison.[7] Most of the fatty acids appear only once in any triglyceride molecule, although small proportions of the triglycerides contain two groups of the same acid (palmitic, or unsaturated C_{18}).

The acids in the fully saturated glycerides in the crocodile fat consisted of mixed glycerides distributed as tripalmitin 2·5%, dipalmitostearin 2·2% and palmitodistearin 2·8%, making a total of 7·5%. In green turtle fat the total fully saturated glyceride content is 9%. In both fats the content of saturated acids is nearly 49%, which is below the minimum arithmetically necessary to ensure the presence of fully saturated glycerides ; this is explicable on the hypothesis put forward by Hilditch[1] that in animal depot-fats the final mixture of component glycerides is the consequence of a bio-hydrogenation process, which has operated after the precursor fatty acids (mainly palmitic and oleic) have been assembled into triglycerides. There is sufficient unsaturated acid (52% mol.) to permit the crocodile fat to be made up of

mixed saturated and unsaturated glycerides. This can be easily seen from Table V, in which mono-unsaturated-disaturated glycerides form 27·7%, and the diunsaturated-monosaturated glycerides 64·8%, of the total.

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Received 14 May, 1954

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THE MOVEMENT OF HIGHER FATTY ACIDS UNDER ELECTROPHORESIS ON FILTER-PAPER STRIPS

By A. JOHN G. BARNETT and D. K. SMITH

In connexion with studies on the possible breakdown of higher fatty acids in silage and in *in vitro* rumen studies, various techniques for the estimations of such acids are being investigated. The present work covers the preliminary exploration of the separation of higher fatty acids by electrophoresis on paper, and a potential application of the method is described.

The electrophoretic separation of proteins and other nitrogenous compounds on paper is an established technique, but, as far as the authors are aware, the use of the method for the separation of the fatty acids does not appear to have been investigated. There are probably two reasons for this. In the first place, the lower fatty acids do not appear to be capable of separation by electrophoresis and, secondly, higher fatty acids and their salts are not sufficiently soluble at room temperature to permit of their identification in a few μl. of solution on filter paper with the traditional indicators. The introduction of specially prepared indicator solutions,[1, 2] employed with a suitable development technique,[3] makes it possible, however, to detect about 80 μg. of even such slightly soluble acids as stearic and palmitic. This was readily established by placing spots (40–80 μl.) of the aqueous solutions of the ammonium salts of these acids on paper and developing according to the above-mentioned methods.[1, 3]

Experimental

Apparatus

The electrophoretic apparatus used consists of two V-shaped Perspex troughs capable of adjustment with respect to one another by means of metal rods. Fig. 1 indicates the general dimensions and layout of the apparatus, and is largely self-explanatory. During the course of a run, the apparatus is placed in a large accumulator jar (50 cm. × 30 cm. × 45 cm.) set on its side and sealed at the open end by a glass plate held in position with Plasticine. Petri dishes containing 3N-ammonia solution are placed in the accumulator to produce an equilibrated atmosphere. The electrodes, of 26-s.w.g. platinum wire wound round glass rods which run the length

of the trough, are connected to a d.c. supply capable of adjustment to give a p.d. of 6 v/cm. Papers, prepared as described below, are set between the Perspex plates of the two halves of the apparatus and the rod positions adjusted in such a fashion that the paper strips (eight in number) are taut after wetting with the appropriate ammonia solution (see below).

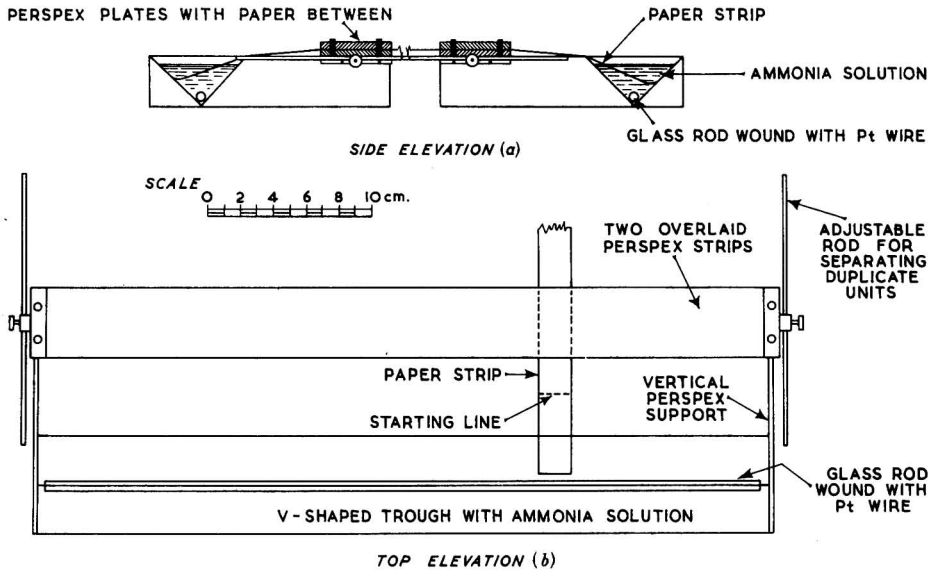

FIG. 1.—*The electrophoresis apparatus*

Paper strips.—Whatman No. 1 chromatographic paper is cut into strips (33 cm. × 2 cm.) which require no further treatment for the C_{12}–C_{18} acids. With lower acids, it was found that an acidic material, apparently inherent in the apparatus, appeared as bands under short runs. However, if a blank run is carried out, as described below, for about three hours and, without removing the paper, the acid—say C_{10}—is adsorbed on to a strip of paper (2 cm. × 0·2 cm.) which is placed on the main paper strip along the starting line, a normal run may be carried through.

Ammonia solution.—3N-Ammonia solution is prepared by passing ammonia by air stream from warmed aqueous solution (sp. gr. 0·880) into distilled water till the required titration value is obtained.

Indicator.—The Duncan & Porteous[1] indicator mixture, consisting of methyl red and bromothymol blue, prepared as these workers indicate, was used.

Fatty acid solutions.—0·2 g. of the acid (C_{10}–C_{18}) was added to 100 ml. of 3N-ammonia solution and gently warmed to effect solution. The product was cooled to 25°, filtered and stored at 25°. Mixed acid solutions were prepared by using 0·2 g. of each acid in the same volume of ammonia solution.

Methods

(1) The papers, prepared as described above, are clamped in the apparatus in such a fashion that the ends lie near the bottoms of the troughs, and the fatty acid solutions are micro-pipetted in bands across the strips between the Perspex clamp at the cathode end of the apparatus and the nearby trough. The bands are placed along a pencilled line 2 cm. from the clamp, and about 80 μl. of fatty acid solution is applied in 8-μl. quantities to each paper. The papers are wetted with 3N-ammonia solution from a wash bottle, starting at the anode end, the troughs being filled with the same solution. The last few cm. near the starting point are allowed to become damp by capillary action. Similarly, capillary action from the trough at the cathode end is sufficient to wet the paper up to the band. Any over-wetting of the paper is to be avoided and any drops

that form should be removed with a piece of dry filter paper. This method allows the two wet fronts ' to converge and eliminates any spread of the band. The wet papers are no longer taut and they are made so by careful adjustment with the side screws on the steel rods. In all runs one or two paper blanks are included with the test strips. After completion of the loading the apparatus is slid into the accumulator jar, which is then sealed. With the eight strips of standard length mentioned above it is found that, in the transformer apparatus used here, a p.d. of 200 v (≡ 6 v/cm.) involves a current of about 1 mA/strip.

At the conclusion of the run the apparatus is removed from the accumulator jar and the strips are left to air-dry in the apparatus after removing the ends from the troughs. When quite dry they are removed, hung up, sprayed and developed according to the method of Duncan & Porteous.[1] The acid bands show up with surprising sharpness and regularity of shape, but a little practice is necessary to achieve the best results.

(2) The R_F values were obtained by spotting the solutions of the ammonium salts of the fatty acids on a sheet of untreated Whatman No. 1 paper, standing the folded sheet in a Petri dish of 3N-ammonia solution in an equilibrated atmosphere and allowing the acids to be displaced by upward movement of the solvent. The acid spots were developed, after drying the sheet, by using the indicator method mentioned above. It was observed that stearic acid did not move, being apparently strongly adsorbed—a finding confirmed by using the downward, instead of the upward, displacement method. This result is in accord with that of Nunez & Spiteri[4] who, with alcoholic solutions of the higher fatty acids in their paper-chromatographic technique, obtained no movement of stearic acid.

(3) The endosmotic flow, under the conditions of the experiment, was determined by pipetting 5-μl. spots of 1% glucose solution in 3N-ammonia solution on paper strips in the electrophoresis apparatus. By using eight paper strips and different positionings of the glucose spots, which were subsequently developed by the method described by Isherwood & Jermyn,[5] it was found that the sugar showed an endosmotic flow of 1·6 cm./h. (from anode to cathode) under a p.d. of 6 v/cm. Paper chromatograms run with glucose and 3N-ammonia solution as solvent showed that the R_F of glucose was 1.

Results

The results obtained by these methods and considerations are given in Table I. The figure for stearic acid was obtained by running at 400 v and not at 200 v because this acid moves extremely slowly. This variation in voltage is legitimate because experiments with other acids, e.g. lauric, showed that doubling the voltage halved the time taken to travel a given distance. Stearic acid thus took 30 hours to move 1 cm. at a p.d. of 400 v.

Table I

The rates of movement of higher fatty acids on paper under electrophoresis and the R_F values of these acids determined by paper chromatography

	Stearic	Palmitic	Myristic	Lauric	Capric
Rate of movement, h./cm. at 6 v/cm.	60	14	3	0·66	0·22
Rate of movement, cm./h.	0·0017	0·07	0·33	1·50	4·50
R_F	?	0·05	0·17	0·46	0·60

If V = true velocity of the acidic ion corrected for adsorption and endosmosis (cm./h. at 6 v/cm.),

and $X = R_F$ value of the organic acid on paper chromatogram,

V_0 = observed velocity (cm./h.),

v = ionic mobility,

E = endosmotic flow (1·6 cm./h., based on glucose),

$V = V_0/X + 1{\cdot}6$ cm./h. at 6 v/cm.

then $$v = \frac{V_0/X + 1{\cdot}6}{3600 \times 6} \text{ cm.}^2 \text{/sec. v.} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

By using equation (1), in which it is assumed that only the ions actually in solution, and not in the interstices of the paper, may move, the results shown for C_{16}–C_{10} are obtained (Table II). The

figures for C_{18} are obtained by extrapolation of the curves resultant on plotting the figures for the determined values of V and v (Fig. 2). They are in that sense approximate. The figures for the ionic mobilities of these acids as determined by the use of equation (1) are compared in Table II with the results of other workers.[6, 7]

Table II

The ionic mobilities of the higher fatty acids as obtained by calculation and compared with the results of other workers

	Stearic	Palmitic	Myristic	Lauric	Capric	
True velocity (V) cm./h. at 6 v/cm.	2·6?	3·0	3·5	4·9	9·1	
Ionic mobility (v) as calculated	13·0?	13·9	16·4	22·5	42·1	$\times 10^{-5}$
Ionic mobility [6, 7]	20·9	22·5	21·6	20·7	—	$\times 10^{-5}$

Potential applications of the method

A sample of oleic acid (B.P.) was obtained and a portion steam-distilled. It was found, by gas-phase partition chromatography,[8] that the straight-chain acids C_2–C_6 were all present in small amount—about 2% *in toto*.

A fresh portion (200 g.) was distilled *in vacuo* at 1 mm. and the following fractions were obtained: F_1, 0–145°; F_2, 145–155°; F_3, 155–163°; F_4, 163–170°.

Solutions of each of the fractions were made (0·3 g./100 ml. of 3N-ammonia solution) and 40-μl. amounts of the solutions used. Each fraction was then examined by paper electrophoresis; five papers were used for each run, four being treated with the fraction and the last being used as a blank. These runs were repeated for each fraction for different periods—12, 24 and 36 and 48 hours—and the following conclusions were reached: F_1 contained C_{12} and C_{14} acids and a higher fatty acid band was left at the starting point; F_2 contained a C_{14} acid and a higher acid band was left at the starting point; F_3 contained an unidentified acid between C_{14} and C_{16} (but much nearer to C_{16}) and a higher acid band was left at the starting point; F_4 contained only the acids left at the starting point. Experiments with pure elaidic and stearic acids indicated that no observable movement occurred from the starting line over 36 hours at 6 v/cm.

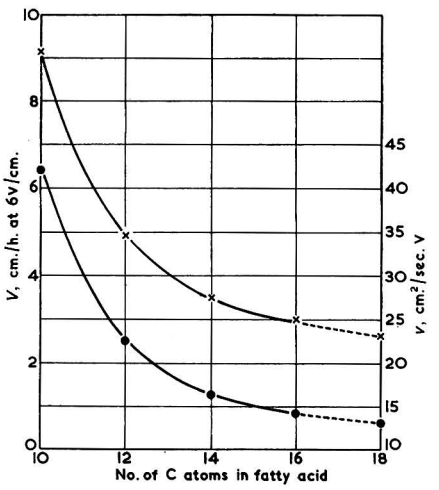

FIG. 2.—*The true velocities of the acidic ions (C_{10}–C_{16}) and the calculated ionic mobilities for the same ions with the corresponding derived values for C_{18}*

V ×——×

v ●——●

An approximate estimate of the amount of C_{12} and C_{14} acids in the original oleic acid was obtained in the following way. In a given five-paper run, the blank was developed to make sure that no artifacts were present and another strip was developed to position the acid under consideration. The three remaining papers were bunched together and the relevant areas cut out as part of 4-cm. pieces. Three pieces of similar length were cut from other parts of the same strips. The two sets of cut paper were then eluted with neutral alcohol and the effluents titrated against aqueous alcoholic 0·01N-sodium hydroxide, with formalized bromocresol purple as indicator. By this method it was shown that the original oleic acid contained 1·5–2% of lauric acid and 0·04% of myristic acid.

The unidentified acid present in F_3 was found to be saturated because, on running the acids obtained by treatment of F_3 with sodium hypochlorite, the band of the unknown acid appeared in its usual position. By using aliquots of the original F_3 fraction, it was found that the acid had an R_F value of 0·06 and v equal to $13{\cdot}2 \times 10^{-5}$ (cf. palmitic, $13{\cdot}9 \times 10^{-5}$), and by paper chromatography[4] of F_3 the acid was found to lie between C_{14} and C_{16}.

Discussion

It is thus clear that although some information may be acquired by this method about the higher fatty acid content of mixtures, the method has severe limitations. Thus although figures are given for the C_{10} acid, acids lower than this appear to move at the same rate on paper under the same conditions. This is in accordance with the general conception that the differences in fundamental properties between the lower fatty acids and the higher fatty acids are very much greater than those normally characteristic of an homologous series. Again, as the method stands, it does not seem possible to separate the various C_{18} acids from one another, because of the high extent of their adsorption on paper.

Acknowledgments

One of the authors (A. J. G. B.) has to thank the Agricultural Research Council for a grant in aid of research assistance which was operative during the period in which this work was carried out. Both authors are grateful to Professor W. O. Kermack and to Dr. P. Meares for their helpful suggestions.

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Received 20 July, 1954

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THE BROWNING REACTION IN DEHYDRATED CARROT AND POTATO: ITS INITIATION AND THE SEPARATION AND PARTIAL CHARACTERIZATION OF AN INTERMEDIATE FROM DEHYDRATED CARROT

By HAROLD G. WAGER

The compounds that initiate the browning reaction in dehydrated carrot were shown to be soluble in water or 60% alcohol. Alcoholic extracts of dehydrated carrot and potato were separated into basic, acidic and neutral fractions by ion-exchange resins and then heated separately and in all combinations at 30% r.h. and 52°. Browning was only considerable when the basic and neutral fractions were both present, indicating that a Maillard type of reaction is probably the first in the chain of reactions leading to browning in carrot and potato.

A limited amount of browning occurred in the basic fraction when heated by itself and this was shown to result from a colourless intermediate of the browning reaction which has been isolated and partially characterized. Its minimum molecular weight was found to be about 235 and its properties lead to the suggestion that it is an *iso*glycosylamine.

Dehydrated vegetables and fruits when stored at 'tropical' temperatures go brown slowly, and this has been widely attributed to a chain of reactions initiated by a combination of glucose with amino-acids (cf. reviews by Stadtman[1] and Danehy & Pigman[2]). A direct test was made by Haas *et al.*[3] with apricot juice. The juice was separated by ion-exchange

resins into a cationic fraction containing the amino-acids, an anionic fraction containing the organic acids and a neutral fraction. These fractions were heated singly and in combination and the results showed that browning reactions were initiated by any pair of fractions, and that the contribution of the combined cationic and neutral fraction to the total browning was relatively small. It seemed desirable to extend work of this type to dehydrated vegetables, and the results described below started from a study of the systems responsible for initiating browning reactions in dried carrot and dried potato.

Part I. Determination of the compounds that initiate the browning reactions in dehydrated carrot and potato

Experimental

Commercially prepared dehydrated strips of carrot and potato were ground to a fine powder and extracted fully with 70% ethanol in water. The ethanol was removed at 20°, the carotenoids were extracted with light petroleum, and the extract was concentrated to 100 ml. and dialysed exhaustively. Three-quarters of the resulting dialysate was passed in succession through columns of 4½%-cross-linked polystyrene and De-Acidite G. Sugars and neutral materials were removed by washing the columns with water and the basic and acidic materials were displaced with 0·1N-sodium hydroxide solution and 0·1N-hydrochloric acid respectively. The three fractions so obtained and the remainder of the carotenoid-free carrot extract were brought to a pH of 6·10 with hydrochloric acid or sodium hydroxide and concentrated. Aliquots, corresponding to 0·5 g. of carrot powder and 1 g. of potato powder, were put into specimen tubes, dried at 20°, equilibrated to 30% r.h. and then, still in an atmosphere of 30% r.h., held at 52° for varying times. The resulting material was dissolved in water and transferred to 60% ethanol. Any water-insoluble brown material was centrifuged off, dissolved in N-sodium hydroxide solution, diluted, neutralized and transferred to 60% ethanol. The extinction coefficient was determined by using a violet (Ilford 601) filter, and the values obtained have been calculated to the whole sample in 25 ml. of 60% ethanol.

Reducing sugars were estimated by the method of Shaffer & Hartmann,[4] as modified by Maskell & Narain (cf. Gawadi[5] and Wager[6]), and sucrose by determining the increase in reducing value after hydrolysis with invertase. Total nitrogen was estimated by the micro-Kjeldahl method.

Paper chromatograms were normally run on Whatman No. 1 paper at 20° in propanol–water (80 : 20), phenol–water (80 : 20) or butanol–acetic acid–water (40 : 10 : 50).

Results

Comparison of the rate of browning of powdered dehydrated carrot and extracts from it

A preliminary experiment was made to determine whether the constituents of dried carrot that browned on heating were water-soluble and whether accelerated storage trials gave results comparable with 'tropical' storage conditions. Accordingly determinations were made of the rate of browning of powdered dried carrot, the water extractives of a similar weight of carrot powder, the extractives after precipitation with 50% ethanol and also of the ethanol precipitate. Samples were equilibrated to 30% and 50% r.h. and heated at 37° and 52°. The brown pigment was extracted with 60% ethanol and the extinction coefficient measured. Progress curves were constructed for each condition and, since these were linear over the range of brownness developed by the samples, the results can be summarized by Table I. The alcohol precipitate did not brown either by itself or when mixed with glucose or glycine. The similarities between the various carrot preparations under the conditions tested are very great. This suggested that essentially the same reactions were proceeding under all the conditions tested and justified the use of a purified extract at a relatively high temperature for further work. The greatest degree of browning was produced in the purest preparation and the most probable explanation would appear to be that the cell walls and the material precipitated by alcohol offer an essentially mechanical interference with the reaction, i.e. they seem to dilute the reaction mixture. It is noticeable that the effect of purification—shown by the size of

Table I

Rate of browning of dried carrot and extracts of it expressed as k (increase in extinction coefficient per day) multiplied by 10^2

	30% r.h.			50% r.h.		
	37°	52°	Q_{10}	37°	52°	Q_{10}
Carrot powder (k_1)	0·146	2·20	6·1	0·399	4·30	4·9
Water extract	0·209	2·83	5·7	0·511	5·05	4·6
Water extract after pptn. by 50% ethanol (k_2)	0·250	3·50	5·8	0·602	5·75	4·5
Ratio k_2/k_1	1·73	1·58		1·51	1·34	

the ratio k_2/k_1 (Table I)—decreases as the viscosity of the material decreases, i.e. as the molecular mobility increases, whether this is a result of increase in temperature or moisture content. The rather marked difference in Q_{10} for the range 37–52° between the 30% and 50% r.h. series may again be correlated with a greater viscosity change at 30% r.h. than at 50% r.h. for the given rise in temperature.

Browning of the various fractions of the extracts of dehydrated carrot and potato

The three fractions from the extracts of dried potato and carrot were examined by paper chromatography for sugars and amino-acids. No glucose, fructose or sucrose was found in either the basic or cationic fraction B or in the acidic or anionic fraction A, and only traces of ninhydrin-reacting material were present in either the A or the neutral N fractions, so that the separation of the amino-acids from the other organic acids and both from the sugars was satisfactory.

The content of ' total ' soluble nitrogen and of sugars in aliquots of the fractions of size similar to those used in preparing the samples for browning is given in Table II. In the carrot sample a considerable loss of nitrogen occurred during the separation into fractions. Subsequent work has shown that the wash liquor from the base-exchange column contained appreciable amounts of combined nitrogen, much of which appears to have been peptide in nature. In the carrot experiment, results of which are plotted in Fig. 1, the base-exchange column was washed with several litres of water to ensure a complete removal of sugars, and presumably the loss of nitrogen occurred at this step. To avoid this, in the experiments with potato the washing of the column was reduced to a minimum.

The progress curves of browning of the individual fractions and all combinations of them for experiments with carrot and potato are plotted in Figs. 1 and 2, and the following conclusions may be drawn from the curves:

(1) Only samples containing both B and N browned to any considerable extent, showing that in these vegetables browning is almost certainly initiated by a reaction between an amino-acid and sugar.

(2) B browned rapidly at first, but soon slowed down to a very low rate. This browning in the absence of free sugars is of great interest and is considered below.

(3) The addition of the acid fraction A to the basic fraction B causes an increase in the rate of browning in the earlier stages and has no effect on the rate later on. The total brownness produced in the (B + A) sample is little more than in the B sample and therefore there

Table II

Composition of the samples: sugars as glucose, mg., and nitrogen, mg.

Fraction	C	B	N	A
' Total ' soluble nitrogen				
Carrot	3·12	1·83	0·126	0·07
Potato	3·80	3·42	0·028	0·064
Reducing value				
Carrot	66·8	—	67·1	—
Potato	9·68	1·81	7·75	0·49
Sucrose				
Carrot	239	—	215	—
Potato	4·33	0·29	3·99	> 0·1

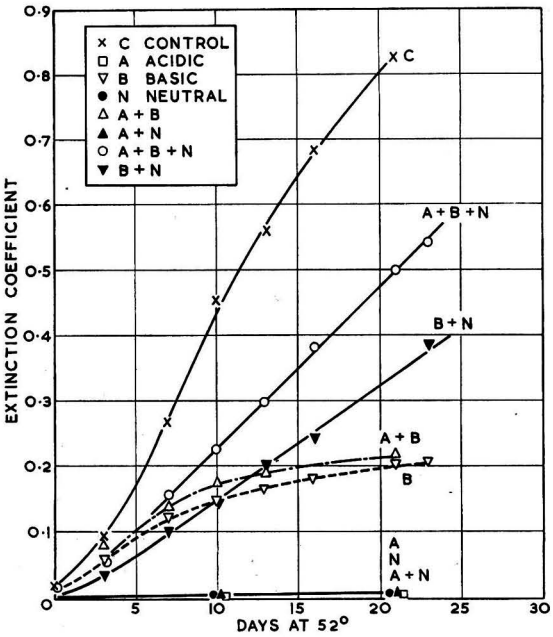

FIG. 1.—*Progress curves of the browning of various fractions of an extract of dried carrot*

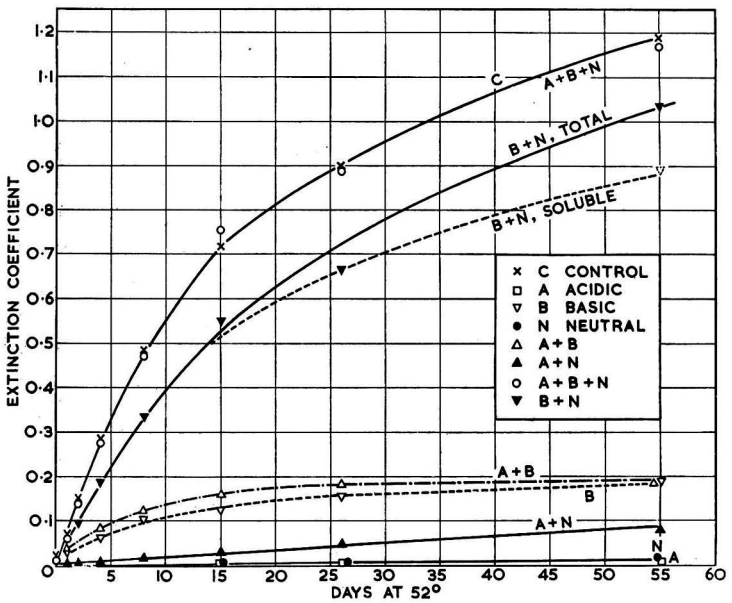

FIG. 2.—*Progress curves of the browning of various fractions of an extract of dried potato*

is no reaction of significant size between the amino-acids and organic acids of extracts of carrot and potato.

(4) The (A + N) fractions from the potato browned slowly and linearly with time. This suggests a different type of browning reaction, but it is so slow as to contribute very little to the colour of the dried vegetable before it would have become uneatable owing to changes following the reaction between amino-acid and sugar.

(5) When A is added to (B + N) the rate of browning is increased beyond that to be expected either from the browning of the A sample itself or from the effect of adding A to either B or N separately. This suggests that the A fraction is influencing the later stages of the reaction chain, either as a reactant or perhaps by buffering the pH. An indication of a change in the nature of the later reactions is the fact that, in one experiment with potato extract, after 60 days at 52° some 27% of the brownness of (B + N) was water-insoluble, but only about 2% of (A + B + N) and none of the unfractionated control C.

(6) The fractions C and (A + B + N) do not brown at identical rates and the variations in different experiments seem random. These differences have not been investigated, but C and (A + B + N) may differ in many ways, such as in the presence or absence of salts, pectin, a little protein and peptide nitrogen, polyphenols and other compounds which might not be eluted freely from the ion-exchange resin.

(7) In some experiments, lag phases of relatively short duration have occurred in the progress curves of browning of some fractions (cf. Fig. 1). Their cause is not known and their occurrence has been sporadic.

Part II. Isolation from an extract of dried carrot of a presumed intermediate in the browning reaction

These results show that the fraction removed by the base-exchange resin browned when heated. Examination of this fraction by paper chromatography showed that there were no reducing spots corresponding to glucose, fructose or sucrose, but that there was a material present which caused a fairly well marked reduction of ammoniacal silver nitrate with an R_F value in propanol–water of approximately 0·1. This reducing material was partially purified by running on paper successively in propanol–water and phenol–water ; the final eluted material browned when heated by itself at 52°. This strongly suggested that the preparation contained an intermediate in the browning reaction and an attempt was made to confirm this and to determine some of its properties.

Extraction and purification of the self-browning material

Commercially prepared dried carrot (1 kg.) was ground to a fine powder and fully extracted with 70% ethanol in water. The ethanol was removed at a reduced pressure below 25°, the carotenoids were extracted with light petroleum and the resulting solution was diluted and passed through a column of base-exchange resin (4½%-cross-linked polystyrene). After thorough washing of the column with distilled water the material on it was displaced with 0·2N-sodium hydroxide solution and collected as a series of fractions. Paper chromatograms of all the fractions were run in propanol–water, phenol–water and butanol–acetic acid–water and developed with ammoniacal silver nitrate. The results with all solvents were similar and those with propanol–water are shown in Fig. 3. Many reducing compounds were present, but only three gave rise to spots of considerable size, i.e. those labelled α, β and δ. The β-spot compound appeared to be present in the largest amount and was selected for further purification. The β- and δ-compounds have the same R_F in propanol but are distinct in phenol–water and butanol–acetic acid–water.

Fraction 32, Fig. 3, containing most of the β-spot material, was put on Whatman No. 3 papers, and run in propanol–water. The strips with the β-spot material were eluted and the eluates concentrated. This treatment was repeated in propanol–water and then followed by running in butanol–acetic acid–water and finally again in propanol–water. There was little change in the appearance of the paper chromatograms subsequent to the first run in propanol–water. There was always present a single spot which reduced silver nitrate strongly (Table III),

and coincident with it in propanol–water, phenol–water and butanol–acetic acid–water was a weak ninhydrin-positive spot; it seems that the same material must cause both reactions. Besides this spot there were two other very weak ninhydrin-positive spots. In spite of apparently cutting these cleanly from the reducing spot in three successive papers they still appeared

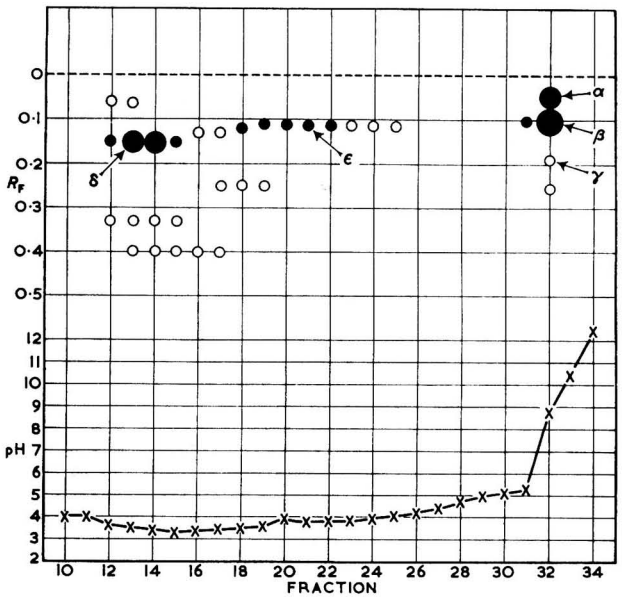

FIG. 3.—*R_F values of the silver nitrate-reducing spots in fractions displaced from a base-exchange resin*

The approximate intensity of the spot is shown by the diameter of the circle and very faint spots are shown as rings. The lower curve is the pH of the fraction.

in much the same low intensity, and it seems likely that they were breakdown products formed during the drying of the samples. There was always a slight browning during this drying even at room temperature, and the low-intensity ninhydrin-positive spot with an R_F value of 0·18 in propanol–water increased greatly in intensity on heating the β-spot compound. The yield of the β-spot compound was 40–50 mg.

Sufficient purification has been carried out on the α- and δ-spot compounds to show that they, like the β-spot compound, brown readily when heated at 52° at pH 6·1. Probably, therefore, they, also, are intermediates in the browning reaction. The only other spot of considerable intensity, the ε-spot, is very probably serine.

Extraction of fresh carrot

About 1 kg. of fresh carrot was scalded and a water extract prepared, which was then treated similarly to the extract from dried carrot. No material was found with silver nitrate-

Table III

R_F values (average) of constituents of the 'purified' β-spot material

	Propanol–water	Phenol–water	Butanol–acetic acid–water
Ammoniacal silver nitrate	0·12	0·76	0·25
Ninhydrin	0·12	0·76	0·25
	0·18*	0·53*	0·20*
		0·62*	0·38*

* The correspondence of these spots in the different solvents is not known

reducing value in the cationic fraction corresponding to the material found in the extracts of dried carrot, nor were any reducing spots or brown material produced by heating the cationic fraction at 52°. Three different samples of fresh carrot were tested with the same negative result, showing that the material in the various reducing spots shown in Fig. 3 was a result of the drying process.

Demonstration that the α- and β-spot compounds are intermediates

To aliquots of the basic fraction of an extract of fresh carrots (containing 8·5 mg. of nitrogen) was added a solution containing 3 mg. of either glucose or fructose. These mixtures were dried at room temperature under reduced pressure, equilibrated for 24 hours in an atmosphere of 30% r.h., heated for up to 40 days at 52° and then dissolved in water and run on paper chromatograms. After 2 days' heating the samples with added sugar had become a very pale brown and after 40 days they were a deep chocolate brown, whereas the controls without sugar did not change in colour.

In the samples containing added glucose the unheated control showed a very faint silver nitrate-reducing spot in the β-position; after 2 hours at 52° this was well marked and the α-position also was showing reducing material. With 6 hours' heating the glucose spot was noticeably weaker and the α- and β-spots were very strong; after 16 hours the glucose spot had disappeared and the α- and β-spots were correspondingly intense. With further heating these became progressively paler and after 40 days were only a little stronger than in the unheated control. A weak reducing spot appeared with an R_F value of 0·19 (cf. the long heating of the β-spot material described below).

In the series with fructose there was equally clear evidence of the production of intermediates, but the whole reaction proceeded much slower. After 2 days there was still fructose left, but it had completely gone in 9 days. Intense silver nitrate-reducing spots occurred in the β-position and a second reducing spot with an R_F of 0·18. At no stage was there much reducing material in the α-position. After 40 days the β-spot was fairly weak and the spot with the higher R_F had disappeared.

In this experiment, therefore, there is a clear demonstration of the production of the α- and β-spot materials from glucose, of their disappearance with further heating and of the concomitant appearance of brown pigment. Fructose reacted more slowly than glucose and gave different intermediate compounds.

Properties of the material of the β-spot

A few μl. of a solution of the β-spot compounds was mixed on a white tile with phosphate buffer at pH 6·0, with the addition of either glucose or glycine. The drops were dried, equilibrated to 30% r.h. and heated at 52° for 2 days. The β-spot material browned freely by itself and there was no increase in colour, as judged by eye, with either added glucose or glycine.

The nitrogen contents of two different preparations of the β-spot material were 6·20 and 5·85%, corresponding to molecular weights (for 1 atom of nitrogen per molecule) of 226 and 239 respectively.

A rather weak reaction with ninhydrin is given by the β-spot compound. It is strongly reducing; there is a slight reduction of ammoniacal silver nitrate in the cold and a strong reaction with a ferricyanide reagent.[7] The Elsan & Morgan test for glycosylamines, as modified for use as a spray by Partridge,[8] was positive, giving a strong pinkish-purple coloration in the cold. Tests for the presence of an aldehydic group by treatment with *p*-phenylenediamine and hydrogen peroxide (Feigl[9] modified), or of a ketonic group by treatment with 2 : 4-dinitrophenylhydrazine in glacial acetic acid in the cold, after 20 min. at the boiling point, or in sodium acetate at pH 7 gave negative results.

The β-spot material was not readily hydrolysed by acid. It was unchanged, as judged by paper chromatography, after being heated for one hour at 100° with N-hydrochloric acid, but after being heated for 8 hours with 6N-hydrochloric acid at 100° it was broken down and several other ninhydrin-positive and silver nitrate-positive spots were produced.

The β-spot material is colourless but goes brown extremely readily. Drying at room temperature leads to some darkening, and the decomposition associated with this has been sug-

gested as being the cause of the weak ninhydrin-positive spots which are present in the samples. A test of the effect of prolonged heating was made by putting a few μg. on paper, equilibrating to 30% r.h., heating at 52°, then running in propanol–water. After 30 days' heating much brown material remained on the starting line, the β-spot had become relatively faint, and two silver nitrate-reducing spots, both more intense than the original β-spot, had appeared with R_F values of 0·18 and 0·22. The two ninhydrin-positive spots present in the β-spot material, with R_F values of 0·13 and 0·18, changed in relative intensity, that of the faster-moving spot changing from about $\frac{1}{10}$ to 8–16 times the intensity of the slower.

Discussion

A water extract of carrot was heated for varying times at 30% r.h. and either 37° or 52° and then examined by paper chromatography with a ninhydrin spray. So far as could be judged visually all the spots decreased in intensity at a more or less similar rate, no one amino-acid disappearing markedly preferentially. A large number of glycosylamines should therefore be formed, and an equal number of other nitrogen-containing intermediates with closely similar properties would be expected if all the glycosylamines decompose in a similar way. The fact that a limited number of reducing spots are produced, and these in very unequal amounts, may be accounted for in various ways. Only certain of the glycosylamines may decompose; alternatively, the intermediates from some glycosylamines may be more labile and in consequence do not accumulate; again, each of the reducing spots may be composite, consisting of intermediates derived from a group of amino-acids with similar properties. No evidence of separation of the β-spot compound has been seen in the present work, but its R_F value in propanol–water is the same as that of the intermediates studied by Hannan & Lea[10] in a model system that is unlikely to occur in carrot.

The properties of the β-spot material are in general similar to those ascribed to intermediates isolated from various model systems (cf. review by Hodge[11]), and these properties have been interpreted as indicating the presence of an *iso*glycosylamine and more specifically of an N-substituted 1-amino-1-deoxy-ketose following an 'Amadori' rearrangement of a glycosylamine. There is as yet, however, no evidence to show that the 'Amadori' rearrangement of a glycosylamine is a general reaction for aliphatic amino-acids (but see Hodge & Rist[12]) so the suggestion that the β-spot material is a 1-amino-1-deoxy-ketose must be regarded as tentative. What is clear is that it is an intermediate of relatively large molecular weight containing nitrogen, and with greater stability to acids, stronger reducing power and less stability to heat than would be expected for an N-substituted aldosylamine.

Acknowledgments

The work described in this paper was carried out as part of the programme of the Food Investigation Organization of the Department of Scientific and Industrial Research. The author thanks Dr. S. M. Partridge for advice on the use of ion-exchange resins. Much of the experimental work of this paper was carried out by Mr. F. A. Porter.

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Received 1 July, 1954

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ABSTRACTS

JANUARY, 1955

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.

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JOURNAL OF THE SCIENCE OF FOOD AND AGRICULTURE

ABSTRACTS

JANUARY, 1955

I.—AGRICULTURE AND HORTICULTURE

Soils of the Northern Marshall atolls, with special reference to the Jemo series. F. H. Fosberg (*Soil Sci.*, 1954, **78**, 99—107).—An ecological survey of the atolls is reported. The Jemo series is described in detail and its origin discussed. T. G. MORRIS.

Silt soils of Eure-et-Loire. J. Garola and R. Cadier-Eberhard (*Ann. Agron.*, 1954, **5**, 61—81).—The physical, chemical, and agronomic characteristics of the soils are described. A. H. CORNFIELD.

Vegetation of the saline soils of Oran. P. Simmoneau (*Ann. Agron.*, 1954, **5**, 91—117, 225—257).—The vegetation and possible agricultural value of the soils are described and discussed. A. H. CORNFIELD.

Fen soils of the Hanság moor. V. Szilva (*Agrokém. Talajt.*, 1953, **2**, 179—184).—The high moisture content of the air-dried soils (5—19%) decreased with decline in sticky-point moisture. The *d* increased from 1·54 to 2·55 with increase in vol.-wt. from 0·33 to 1·142. Soils of high moisture content and loss-on-ignition (>20%) and low density and ash (<70%) content were the more subject to wind erosion and winter freezing and less productive than those showing the opposite characteristics. SOILS & FERT. (A. G. P.).

Agronomic study of the Champeigne Tourangelle. L. Depardon (*Ann. Agron.*, 1954, **5**, 83—89).—The climate, geological and physical properties and nutrient status of the soils of the region are described. Fertiliser recommendations for a variety of crops are given. A. H. CORNFIELD.

Cyclic salt as dominant factor in genesis of soils in south-east Australia. R. G. Downes (*Aust. J. agric. Res.*, 1954, **5**, 448—464).—During the recent arid period the rainfall was approx. half that at present, and this probably enabled cyclic salt to be accumulated in areas in south-east Australia, where it no longer accumulates. R. H. HURST.

Mechanical analysis of soils. S. Mériaux (*Ann. Agron.*, 1954, **5**, 5—59, 149—205).—A detailed study of mechanical analysis methods involving the measurement of the optical extinction of suspensions and the density of suspensions was made. The latter method is considered the more suitable and a modified procedure is described. A. H. CORNFIELD.

Soil sieving machine. P. N. Carpenter (*Agron. J.*, 1954, **46**, 181—182).—An automatic dry sieving machine is described. A. H. CORNFIELD.

Relation of moisture-holding capacity with certain soil constants. S. N. Prasad and H. Sinha (*J. Inst. Chem., India*, 1954, **26**, 153—158).—Data are presented in regard to ~60 soil samples. The moisture-holding capacity has highly significant correlation with apparent density, clay, and clay + silt, but not with org. matter. E. M. J.

Soil factors affecting constant water level subirrigation. R. L. Cook, A. E. Erickson, and P. R. Krone (*Proc. Amer. Soc. hort. Sci.*, 1953, **62**, 491—496).—Two soils, a sandy loam and a well aggregated clay loam were used for growing *Antirrhinum* plants under a system of constant water level irrigation. Best blooms were produced in sandy loam when the water level was 21 in. and in the clay loam when it was 9 in. below the soil surface. L. G. G. WARNE.

Slope irrigation. W. van der Merwe, D. G. Wessels, and T. P. Pretorius (*Union S. Afr. Dep. Agric., Agric. Educ. Res. Ser.* 11 ; *Sci. Bull.*, 350, 53—62).—Tabular data are presented of beds of different slopes, lengths, and widths, and sown to different crops using different strengths of stream. E. G. BRICKELL.

Leaching losses, run-off, and percolate from eight Illinois soils. R. S. Stauffer and R. H. Rush (*Agron. J.*, 1954, **46**, 207—211).—The relationships between annual percolate and annual losses of soil constituents (Ca, Mg, K, Na, N, S, SiO_2, R_2O_3) by leaching from 8 Illinois soils over a 10-year period are reported. Although all soils were silt loams, differences in percolate, run-off, and losses of nutrients varied widely. Nutrient losses were usually, but not always, correlated with amount of percolate. A. H. CORNFIELD.

Synthetic soil conditioners. G. R. Moss, H. A. Browning, and T. F. Southon (*N.Z. J. Agric.*, 1954, **88**, 67—69).—In preliminary experiments Krilium conditioner increased aggregation in heavy soils, increased the yield of mustard in pot trials, and markedly reduced the run-off of water after heavy rains. A. G. POLLARD.

Influence of tillage on growth of sugar beet and on soil structure. Trials on a loamy soil of excellent structure. M. Simon (*Inst. Belg. Amélior. Better. Pub.*, 1953, **21**, 3—16).—No significant differences in crop yield or soil structure were apparent between a soil receiving 1—6 surface cultivations and that tilled up to 9 times to 8 cm. Repeated deep tillage may affect adversely crop yields and structure of the soil ; infrequent deep tillage may leave the seed-bed cold and delay seedling emergence. SOILS & FERT. (A. G. P.).

Importance for soil fertility of ploughing depth in conjunction with fertilising ; long-term experiments at Dahlem. K. Opitz and E. Tamm (*Z. Acker-u. PflBau*, 1953, **96**, 261—308).—The soils examined were podzolic loams, poor in Ca, humus, and N and of good K but moderate P content. Deep ploughing and liming both improved the physical properties of the soil the former having the greater influence. Shallow cultivation for nine years markedly increased subsoil acidity and decreased buffer capacity, K-absorbing power, and P content ; deep ploughing maintained a satisfactory pH for 18 years. In the 0—30 cm. layer there were little differences in nutrient distribution between deep- and shallow-ploughed soils although differences in assimilable P appeared after 14 years. Deep ploughing increased the org. N and C contents throughout the profile ; shallow ploughing decreased both constituents in the subsoil and slightly increased the N content of the surface layer. The soil microflora benefited from deep ploughing : shallow cultivation increased fungi at the expense of bacteria and almost exterminated *Azotobacter*. Yields were increased by (*a*) deep ploughing, (*b*) liming, (*c*) P manuring to extents diminishing in the order named. Farmyard manure had a greater residual action on potatoes than on cereals. SOILS & FERT. (A. G. P.).

Spectrographic analysis of exchangeable cations in soils. F. Burriel Martí, S. Jiménez Gómez, and C. Alvarez (*An. real Soc. esp. Fís. Quím.*, 1954, **50, B**, 663—672).—In the determination spectrographically of Na, K, Mg, Pb, and Mn in the concentrations found in Spanish soils, 2700 to 4300 A. is the best region. Calciferous soils are best determined in the region 3000—6250 A. but Mg is not determinable in this zone. T. R. MANLEY.

Direct reading electrophotometer. P. N. Carpenter and H. S. Ingraham (*Agron. J.*, 1954, **46**, 182).—The construction of an electrophotometer for rapidly measuring the intensity of colours produced in chemical soil tests is described. A. H. CORNFIELD.

Determination of phosphate as ammonium phosphomolybdate. L. Gachon (*Ann. Agron.*, 1954, **5**, 259—283).—A critical study was made of methods used for determining P as NH_4 phosphomolybdate. A modified method for determining P in the citric acid extracts of soils and in plant material, based on the determination of the NH_3 (by distillation) in the phosphomolybdate ppt., is described. A. H. CORNFIELD.

Available phosphorus status of Nebraska soils in relation to series classification, time of sampling, and method of measurement. R. A. Olson, M. B. Rhodes, and A. F. Dreier (*Agron. J.*, 1954, **46**, 175—180).—Available P as measured by four chemical methods, pH, and % yield-response to P applications were closely related to soil series for soils belonging to 15 of the major soil series used for crop production in Nebraska. Olsen's $NaHCO_3$ and the Bray-Kurtz No. 1 methods were the most satisfactory of the chemical tests for soils ranging in texture from sands to clays and for very acid to calcareous soils. All methods showed a seasonal fluctuation in soil P status, availability being at a max. in Mar.–April. A. H. CORNFIELD.

Residual phosphorus availability in long-time rotations on calcareous soils. S. R. Olsen, F. S. Watanabe, H. R. Cosper, W. E. Larson, and L. B. Nelson (*Soil Sci.*, 1954, **78**, 141—151).—Sol. P levels in three calcareous soils were determined by several methods (Bray, $NaHCO_3$, H_2O, CO_2), as well as total P. The "residual P" in the soil was calculated as the difference between the total P in the fertilised and unfertilised plots. Oats were grown on these soils, with the addition, in some cases, of resin P (^{32}P adsorbed on ion-exchange resin). The oats responded to the residual P in the soils not receiving resin P, and on resin P-treated plots further increases were found, but on one soil only. In most cases the total P uptake reflected the residual P levels, in addition to freshly added resin P. The A val. (the amount of P in the soil equiv. in availability to the P supplied as resin P) was highly correlated with both the percentage of max. yield measured in the greenhouse and the total P uptake by oats. In addition the A val. was

highly correlated with results of chemical methods of extraction. The P residues were from 26 to 58% as efficient as fresh resin P depending on the soil. The availability of resin P was similar to that of super phosphate. T. G. MORRIS.

Loss of nitrogen through reaction of ammonium and nitrite ions. A. Wahhab and F. Uddin (*Soil Sci.*, 1954, **78**, 119—126).—Losses due to the interaction of $NH_4^{\cdot}$ and NO_2' ions were negligible in sandy and loam soils treated with $(NH_4)_2SO_4$ and $NaNO_2$ whether dried in the air or kept moist. Losses were increased when the concn. of both forms of N were increased. NO_2'-N loss was increased by increasing the relative concn. of $NH_4^{\cdot}$. With higher amounts of both ions losses occurred only on desiccation. Temp. had no effect and the presence of soil was not necessary. With slightly alkaline solutions losses of N through volatilisation of NH_3 and the spontaneous decomposition of NO_2' were much higher than those due to interaction. With highly alkaline soils interaction losses were high. T. G. MORRIS.

Multiple regression analysis of soil data. C. H. Wadleigh and M. Fireman (*Soil Sci.*, 1954, **78**, 127—139).—Two areas of irrigated lands, unproductive because of salt or alkali accumulations, were examined. Laboratory measurements of pH, saturation percentage, texture, sol. salt content, org. matter content, and settling vol. were correlated with laboratory permeability measurements, which, in the case of one soil was highly correlated with field infiltration rate, this being assumed to be the best criterion for irrigation agriculture. By means of multiple regression analysis exchangeable Na, pH and settling vol. in this soil were evaluated in regard to their effect on the laboratory permeability; 88% of the variance was accounted for by these values, and the soil could be adequately characterised by them. With the other soil, in which field infiltration rate and laboratory permeability rate were not significantly correlated the same measurements accounted for only 53% of the variance, indicating that other laboratory measurements were necessary. T. G. MORRIS.

Plot border effects in a liming experiment. A. J. Ohlrogge (*Agron. J.*, 1954, **46**, 241—242).—A 3·5 ft. untreated border strip was left between plots of a liming experiment. After 21 years of cross-plot cultivation soil pH indicated that the border effect had extended to 8—10 ft. A. H. CORNFIELD.

Decomposition of root residues of clover, lucerne, and sanfoin [in soil]. S. I. Ilmenev (*Soviet. Agron.*, 1953, No. 2, 56—63).—A year after ploughing-in a clover sward 20% of the main roots retained their structure. Lucerne roots ploughed-in in summer showed 37—40% retention of structure in Oct. SOILS & FERT. (A. G. P.).

Protein–montmorillonite complexes, their preparation and the effects of soil micro-organisms on their decomposition. L. A. Pinck, R. S. Dyal, and F. E. Allison (*Soil Sci.*, 1954, **78**, 109—118).—Gelatin–montmorillonite complexes were prepared by (i) mixing an aq. suspension of H montmorillonite with aq. gelatin and shaking, the pH of the solution being increased by $Ca(OH)_2$, (ii) adding solid H montmorillonite slowly to aq. acidified (HCl) gelatin at a pH of 2·5, followed by addition of $Ca(OH)_2$, (iii) mixing suspensions of montmorillonite and gelatin in aq. NaOH (pH 10) and subsequently lowering the pH to 2·5 by HCl. The prepared materials were mixed with sand and a nutrient solution together with soil infusion as inoculant. CO_2 evolved was determined. Only about 20% of the protein present in complexes containing 10% of protein and having a *c*-spacing of 15 A. in which most of the protein was in the form of a monolayer, was decomposed in four weeks, probably due to the inability of proteolytic enzymes to penetrate the layers of these preparations. Where two or more layers of protein were present the decomposition was similar to that of protein added to sand. *X*-Ray studies showed that new monolayer complexes were formed but only half the spaces between the layers were filled. T. G. MORRIS.

Activity of micro-organisms affecting nitrogen, phosphorus, and carbon changes in soil. A. N. Pathak (*Agra Univ. J. Res.*, 1954, **3**, 217—232).—Soil was treated with varying amounts of $(NH_4)_2SO_4$, superphosphate (**I**), or filter paper (**II**). Increase in the numbers of fungi, actinomyces and bacteria and CO_2 evolution resulted from all the treatments. Total N increased in samples treated with **I** or **II**. N increased but **II** greatly lowered phosphate availability. E. G. BRICKELL.

Utilisation of humic substances by soil micro-organisms. I. V. Aleksandrova (*Pochvovedenie*, 1953, No. 6, 23—30).—Soil organisms able to utilise humic matter as sole source of C grew better on media containing easily available org. C. Sulphate-reducing organisms can utilise humic acids. Water-sol. org. compounds present in solonetz soils are widely distributed in stony steppe soils. SOILS & FERT. (A. G. P.).

Survival of fungi in five-year-old dried soil cultures. R. G. Atkinson (*Canad. J. Bot.*, 1954, **32**, 673—678).—The populations of fungi surviving after five years were highest for *Chætomium indicum* and *C. spirale*, followed in descending order by *Fusarium oxysporum* var. *redolens*, *Circinella spinoso*, *Penicillium janthinellum*, *Penicillium purpurogenum*, and two isolates of *Fusarium oxysporum*. R. H. HURST.

Magnesium requirements of *Azotobacter* and *Beijerinckia*, with some additional notes on the latter genus. H. L. Jensen (*Acta agric. scand.*, 1954, **4**, 224—236).—*A. chroöccoccum* and *A. vinelandii* required more Mg than did other Gram-negative bacteria but the requirement was related to the nature and concn. of PO_4'''. *B. indica* and *B. lacticogenes* had far smaller Mg. demands. E. G. BRICKELL.

Production of antibiotics in soil. I. Production of gliotoxin by *Trichoderma viride*. J. M. Wright (*Ann. appl. Biol.*, 1954, **41**, 280—289).—High yields of an antibiotic (probably gliotoxin) were obtained from both an acid humic sandy soil and a moderately acid loam after treatment with org. material, incubation, and inoculation with *T. viride*. No antibiotic was produced when inoculation was not practised and only the sandy soil produced antibiotic in absence of added org. material. There was no simple relationship between antibiotic production and soil pH. The effect of autoclaving in stimulating antibiotic production was traced to elimination of competing microflora and increased availability of N and more especially of C compounds. A. H. CORNFIELD.

Relationship between antibiotic properties of species of *Streptomyces* and their soils. J. Horváth, J. Szolnoki, and L. Felföldy (*Acta biol. Acad. Sci., Hung.*, 1953, **4**, 453—470).—No relationship was apparent between the antibiotic characteristics of *Streptomyces* spp. and the physical properties, pH, or humus content of the soil from which they were isolated, or between the no. of antagonistic organisms and the vegetation or state of cultivation of the soils. Antagonistic strains of *Streptomyces* did not occur in soils in constant contact with rainwater, *e.g.*, on steep slopes, in subsoils, or in very young soils. SOILS & FERT. (A. G. P.).

Antibiotic activity of soil micro-organisms as related to bacterial plant pathogens. Z. A. Patrick (*Canad. J. Bot.*, 1954, **32**, 705—735).—Comparison was made of the no. of antagonists detected when different plant pathogens were used as test organisms in determining the antibiotic potential of virgin soils. *Xanthomonas* species were the most sensitive to the antagonistic soil microflora, while the soft-rot-causing *Erwinia* species were most resistant. Each antagonist was characterised by a specific antibacterial spectrum, and those antagonists having the most intense antibiotic activity usually inhibited the largest no. of bacterial species. The high specificity of some of the antibiotic reactions was used to separate closely related species (*e.g.*, *E. carotovora* and *E. atroseptica*, or *X. corylina* and *X. juglandis*. R. H. HURST.

Microbiology of stubble-mulching. T. M. McCalla (*Nebraska agric. Exp. Sta.*, 1953, Bull. 417, 14 pp.).—Effects of ploughing and stubble-mulching on soil micro-organisms are compared. Roots of *Carex filifolia* probably remain in soil for 35—40 years. Maize cobs persisted longer than wheat straw, maize stalks, or sorghum. Stubble-mulching stimulated aerobic organisms, improved the stability of soil aggregates, and increased infiltration. In the surface 1 in. layer of soil, fungi, aerobic bacteria, and actinomycetes were more numerous under mulch than under ploughing. Denitrifying organisms tended to increase under a mulch. Mulching increased the earthworm population of the surface 1—8 in. Clover residues left in the soil surface lost > 5 lb. of N per acre per season. In deep samplings there was 7—10% less NO_3' in mulched than in ploughed plots. Adequate N, both total and available, can be maintained by stubble-mulching with legumes. SOILS & FERT. (A. G. P.).

Utilisation of Sunn hemp. W. van der Merwe, D. G. Wessels, and T. P. Pretorius (*Union S. Afr. Dep. Agric., Agric. Educ. Res.* Ser. 11; *Sci. Bull.* 350, 37—41).—Addition to soils as compost is recommended and is the only treatment which, after two seasons, will give a yield significantly better than that of mineral N. E. G. BRICKELL.

Rapid method for determination of actual humifying efficiency of organic soil-improvers. J. Pomot and P. Lecat (*C. R. Acad. Agric. Fr.*, 1954, **40**, 494—499).—The test depends on the measurement, by the ^{32}P technique, of the effect of the presence of the org. matter in a non-nutrient "soil" on ^{32}P-uptake by rye seedlings. Rye is sown in 750-ml. pots (40 seeds per pot, in two concentric circles round a central tube), each containing a mixture of sand (250 g.) and granulated SiO_2 (100 g., 3—4 mm. in diameter), with a drainage layer of SiO_2 granules (50 g.). The mixture in each of the test-pots is incorporated with 350 mg. of the org. matter under test, and blank pots are set up without org. matter. After adding to each pot, through the central tube, 60 ml. of aq. 0·1% (wt./vol.) $NH_4H_2{}^{32}PO_4$, the pots are incubated at 20° (±1°) under constant illumination during eight days; the average radioactivities of the aërial part of the seedlings (divested of the coleoptile) are then determined by

means of a Geiger counter. Determinations on sets of six seedlings (equally divided between the outer and inner circles) from two or three pots (blanks as well as tests) are necessary and sufficient. The humification factor for the org. matter is calculated from the formula: $1000(H - T)/T$, where H and T = the average counts per min. for the seedlings from the tests and blanks, respectively. P. S. ARUP.

Nutrient status and cultivation practices of soils of north-west wheat belt of New South Wales. E. G. Hallsworth, F. R. Gibbons, and T. H. Lemerle (*Aust. J. agric. Res.*, 1954, **5**, 422—447).—The N, org. C, PO_4''', and pH of the wheat soils, and the cultivation practices adopted, are reported. The soils are generally high in both total and available PO_4'''. The average yields of wheat on the chernogemic soils are distinctly higher than those on the red-brown earths and red solodic soils, in some of which N is limiting. R. H. HURST.

Hydraulically controlled weighing equipment for use on field plots. L. S. Robertson and J. F. Davis (*Agron. J.*, 1954, **46**, 289).—The equipment is described. A. H. CORNFIELD.

Cultivator for eliminating soil-surface compaction by tractors. C. L. W. Swanson (*Agron. J.*, 1954, **46**, 237—240).—The cultivator, which weeds the soil without causing compaction, is described. A. H. CORNFIELD.

Developments during 50 years in the use of fertilisers. K. J. B. de Kleermaeker (*Chem. Weekbl.*, 1954, **50**, 565—570).—A review embodying statistical data from Holland. P. S. ARUP.

Fertiliser experiments at the Vaalhartz Agricultural Research Station (1946–50). D. G. Wessels and T. P. Pretorius (*Union S. Afr. Dep. Agric., Chem. Ser.* 193; *Sci. Bull.* 338, 76 pp.).—A report on experiments on crop fertilisers, kraal manure, compost, lucerne fertiliser, rock phosphate fertiliser, top-dressing, soil moisture, etc. The results are given in 37 detailed tables. E. G. BRICKELL.

Trials with granular phosphate-yielding slag, manufactured by new method. S. Trocmé and G. Barbier (*C. R. Acad. Agric. Fr.*, 1954, **40**, 196—201).—Preliminary trials indicate that granular basic slag, produced by dropping the melted slag into water, is not inferior to ordinary basic slag as regards its capacity to yield P to the soil, or to its fertilising value. P. S. ARUP.

Composition of phosphate-yielding slags. M. Servigne (*C. R. Acad. Agric. Fr.*, 1954, **40**, 195—196).—Trace-element contents of 152 samples of basic slag from 14 factories were: V and Ti, generally ~0·01 and 0·001%, respectively, in all samples; Cr, slight traces in some samples; other trace-elements (except Mn) of biological importance, Pb and rare earth metals, and radioactive material, nil. P. S. ARUP.

Influence of fertilisers on soil structure. F. Nieschlag (*Phosphorsäure*, 1953, **13**, 177—189).—Effects of P, K, CaO, and trace elements on structure in various soil types are examined. In clays treatments favouring microbial development are of first importance: green manuring is the chief method available. In moor soils CaO and P have a direct and K and N an indirect action in improving structure. SOILS & FERT. (A. G. P.).

Continuous ammoniator for superphosphates and fertiliser mixtures. L. D. Yates, F. T. Nielsson, and G. C. Hicks (*Farm. Chem.*, 1954, **117**, No. 7, 38—48; No. 8, 34—41).—The design and operation of appropriate plant are described. The essential principle is the introduction of NH_3 (solution, gas, or liquid), beneath a mass of superphosphate which is being rolled in a cylinder. Data presented show the chemical reactions involved in the prep. and the composition and availability to plants of products obtained by use of varying proportions of materials under different operational conditions. A. G. POLLARD.

Influence of surface-active agents in superphosphate mixed-fertiliser production. E. J. Fox, J. O. Hardesly, and R. Kumagai (*Farm. Chem.*, 1954, **117**, No. 9, 43—47).—Addition of anionic surface-active material (alkylnaphthalenesulphonate) diminished the rate and extent of the reaction between H_2SO_4 and rock phosphate and tended to produce a harder and denser product. Non-ionic surface-active agents compatible with H_2SO_4 (*e.g.*, a condensation product of tridecyl alcohol and ethylene oxide) slightly accelerated the reaction, lowered the density of the product, and increased the NH_3 retained during the subsequent ammoniation process. A. G. POLLARD.

Effect of different phosphate carriers and lime on the yield and phosphorus content of lucerne, beans, and wheat. H. W. Hough (*Dissert. Abstr.*, 1954, **14**, 1123).—Using six types of phosphates, applications were made at two levels on limed and unlimed soil in pot tests. Details are given. For all crops the concn. of P. in the part of the plant taken for yield, had no correlation with yield. In field tests, the beans were grown with 80 lb. per acre of total P_2O_5 supplied by each of the types of phosphate plus concentrated superphosphate. There were no significant differences in yield resulting from the differences in sources of phosphate. A significant negative correlation was obtained between the pH of field plot soil and the concn. of soil P using Bray's adsorbed method and the extracting reagent at a dilution of 1 : 50. E. M. J.

Caking of granular fertilisers. W. A. Mitchell (*J. Sci. Food Agric.*, 1954, **5**, 455—456).—*X*-Ray crystallographic and optical data show that caking of compound granular fertilisers during storage is due to crystallisation, in the presence of moisture, of the NH_4Cl which is formed during manufacture from the $(NH_4)_2SO_4$ and KCl and which concentrates by sublimation on the granule surface during drying. Thorough drying is necessary to prevent caking, but high temp. increase the sublimation and should be avoided. S. C. JOLLY.

Fertiliser placement. I. Fertiliser placement for swedes and turnips in Scotland. J. W. S. Reith. **II. Fertiliser placement in England.** G. W. Cooke (*J. Sci. Food Agric.*, 1954, **5**, 421—428, 429—440).—I. Placement (*A*) and broadcast (*B*) applications of $(NH_4)_2SO_4$, superphosphate (**I**), KCl (**II**), 40% K salts (**III**) and two granular NPK fertilisers have been compared in field trials; *A* at distances >3 in. to the side of the row and >3·5 in. below the soil surface was examined. Higher yields were given consistently by **I** placed 3—3·5 in. directly below the seed than in other positions or by *B*. With $(NH_4)_2SO_4$, *A* had no advantages over *B*, and when placed directly below the seed may harm early growth. With **II**, results were equally good with *A* and *B*, but with **III** *B* is probably better than *A*. With NPK fertilisers, *A* has no advantage, probably due to the positive effect of P being counterbalanced by the negative effect of the N and K.

II. With cereals, P and K fertilisers gave the best results if drilled with the seeds. With potatoes, fertiliser dressings applied in bands below the seed gave higher yields and more profit than did *B*. With beans and peas, *A* gave higher yields than did *B*. Absence of crop responses in field trials may be due to wrong placement of fertiliser. Some crops, *e.g.*, sugar beet, mangolds, and kale, made better early growth when NPK fertiliser was placed beside the seed than with *B*, but harvest yields were similar. With established temporary and permanent herbage crops, PK fertilisers gave higher yields by *B* than by *A*; with lucerne *A* was not superior to *B*. With light dressings of **I** placed directly beneath the seed as "starter," lucerne grew more rapidly and produced higher yields than with *B*. Fertilisers broadcast and incorporated deeply have advantages over dressings worked-in shallowly in dry seasons and for deep-rooting crops. Root growth of most crops was stimulated by dressings of mixed fertilisers placed near the seed; N, P, and K fertilisers each stimulated extra root growth of peas. Factors affecting value of dressings are discussed, with particular reference to root systems developed. S. C. JOLLY.

Nitrogen treatment of "plant bands." J. Wiebe and J. Carew (*Proc. Amer. Soc. hort. Sci.*, 1953, **62**, 384—390).—"Plant bands" are paper or fibre board pots in which plants are raised and set out, in the pot, in the field. In the experiments described N [urea, or a mixture of $NaNO_3$, $(NH_4)_2SO_4$, and urea] was applied to the inner surface of the pot material as a spray at the rate of 0, 0·25, 0·50, or 0·75 lb. of N per 500 sq. ft. The higher levels of N produced some toxic effects and generally in the early stages of growth the low N-levels were best. Later when band (pot) decomposition was progressing the higher N-levels gave increased growth. L. G. G. WARNE.

Changes in organic matter content in experimental fields at Grignon. R. Morel, A. Richer, and P. Masson (*C. R. Acad. Agric. Fr.*, 1954, **40**, 487—491).—Losses of N in soils which had carried non-leguminous crop rotations during 14 years were insignificant for plots which had received annual dressings of farmyard manure or NPK fertiliser, appreciable for NP or NK plots, and highest for plots which had received no N or no fertiliser at all. No appreciable variations occurred in the C : N ratios. Coeff. of humus destruction per annum (cf. Hénin and Dupuis, *Ann. Agron.*, 1945, 17) were 0·80—1·36%. P. S. ARUP.

Utilisation of phosphorus by sugar beets as affected by fertiliser placement. K. Lawton, A. E. Erickson, and L. S. Robertson (*Agron. J.*, 1954, **46**, 262—264).—Early in the growing season greater utilisation of fertiliser P (ammoniated superphosphate) occurred where the fertiliser was banded (1·5 in. to side and 2 in. below the seed at planting time) than where it was drilled (in rows 7 in. apart and 3 in. deep before seeding). With banding utilisation decreased with the season, whilst the reverse occurred with drilling. There was considerable utilisation of P applied as a sidedressing two months after sowing. Yields of beet were increased by all methods of placement, but there were only slight differences in yields between methods of placement. A. H. CORNFIELD.

Mathematical introduction to agricultural research. I. A. Pastac (*Chim. et Industr.*, 1954, **71**, 1144—1154).—The application of the

theory presented previously (*ibid.*, 1952, **68,** 896) to the determination of the combinations of fertilisers required for obtaining optimum results (total weight, yield of sugar or starch, etc.) is discussed.
J. M. JACOBS.

Radioactive tracer techniques in problems of plant nutrition and crop protection. W. D. E. Thomas (*A.R. Agric. hort. Res. Sta. Bristol*, 1953, 102—108).—A review and summary of work at Long Ashton, 1948—53. A. H. CORNFIELD.

Ion density and biological effectiveness of radiations. L. Ehrenberg and N. Nybom (*Acta agric. scand.*, 1954, **4,** 396—418).—Dry dormant and germinating seeds of barley were irradiated with neutrons or *X*-rays and then allowed to germinate. The lethal effect of neutrons was at least 20 times that of *X*-rays. In both treatments growth was reduced but the action of the neutrons was more uniform, leading to small deviations of the individuals from their mean val.; there were much greater differences between the sensitiveness of individual seeds to *X*-rays. Chemical protection or varying O_2 tension does not influence the neutron effect as it does that of *X*-rays. It was found that the densely ionising radiations act more on the hereditary material than do the others. Neutrons give a higher total yield of mutations than do *X*-rays.
T. G. MORRIS.

Ionising radiations: mechanism of action and dosimetry. L. Ehrenberg (*Acta agric. scand.*, 1954, **4,** 365—395).—The mechanism of biological action of radiations is reviewed, instruments available for the production of different types of ionising particles and different methods for the dose measurement are examined.
T. G. MORRIS.

Plant nutrient utilisation. Effect of uptake of radiocalcium. Hyde S. Jacobs and J. V. Jordan (*J. Agric. Food Chem.*, 1954, **2,** 934—937).—In experiments using gypsum (**I**), $CaCO_3$, and green manure (Alaska peas grown in sand culture using a nutrient solution containing labelled $CaCl_2$) (**II**), all labelled with ^{45}Ca, as Ca source for the test crop (barley), Ca availability (*A*) and yield of total plant material was greater with **I** and **II** than with $CaCO_3$. The ratio of soil Ca to fertiliser Ca on the soil exchange complex was related apparently to *A*. More sol. Ca was furnished by **II** than by the mineral sources. pH and the very low concn. of sol. Al, Fe, and Mn had no effect on *A*. S. C. JOLLY.

Foliar absorption and translocation of radio-phosphorus by *Chrysanthemum morifolium*. S. Asen, S. H. Wittwer, and O. N. Hinsvark (*Proc. Amer. Soc. hort. Sci.*, 1953, **62,** 466—470).—The foliage of rooted cuttings was momentarily dipped by immersion of the plants in 0·3% aq. orthophosphoric acid having an activity of 0·5 μc. per mg. of P. One to four such treatments were given. Appreciable absorption occurred and the absorbed P was rapidly translocated to the roots of the plants. L. G. G. WARNE.

Uptake of ^{14}C from carboxyl-labelled sodium acetate by *Digitalis purpurea* L. E. H. Djao and H. W. Youngken, jun. (*J. Amer. Pharm. Ass.*, 1954, **43,** 425—429).—In a 12-hr. period 9·9% ^{14}C accumulated in the root and 0·17% in the leaves. Root-^{14}C then decreased during the next 10 days, but equilibrium between root and leaf ^{14}C was not attained in 15 days. J. CALEY.

Comparison of methods for preparing thin-tissue plant leaves for autoradiography. S. J. Toth and E. M. Romney (*Soil Sci.*, 1954, **78,** 95—98).—Methods for dehydrating leaves containing ^{60}Co and ^{54}Mn prior to the prep. of autoradiographs have been compared. Little differences were found in the distribution patterns of the radio-elements in soya-bean leaves when dehydrated by (i) placing between absorbent paper and drying in a botanical press, (ii) quick freezing in a dry ice chest, (iii) placing between porous cards and then freeze-drying in a vac., or (iv) quick freezing in dry ice between porous paper, immersion in propylene glycol, and finally drying by evaporation. T. G. MORRIS.

Reaction of potatoes to *X*-irradiation and radiophosphorus. A. Hagberg and N. Nybom (*Acta agric. scand.*, 1954, **4,** 478—584).—*X*-Ray treatment of potatoes had an immediate damaging effect on germination in the greenhouse for all doses from 1250 r. or 20,000 r. After seven weeks there was possibly slight stimulation at the lower doses. At the highest dose the sprouts formed could not penetrate the soil. Radio-phosphorus treatment had no deleterious effect. In the field, tubers treated with 10,000 r. and upwards gave no plants; 5000 r. delayed the development of plants and lower doses gave normal no. with normal habit, but the vitality, as measured by the top size was reduced. Tubers treated with 500 μc. of ^{32}P had delayed germination and their vitality was poor. Several morphological changes appeared in the ^{32}P-treated plants, *e.g.*, succulent leaves with subnormal no. of leaflets and aerial tubers. T. G. MORRIS.

Extra-fascicular transport of water in roots. [A.B.] M. Hülsbruch (*Planta*, 1954, **43,** 566—570; **44,** 102. [c.] L. Bauer, *ibid.*, **44,** 99—101).—[A.B.], and [c.] Polemical discussion concerning the interpretation of results obtained by the berberin sulphate method for tracing routes of water transport in the adventitious roots of *Vicia faba*. P. S. ARUP.

Plasmolytic determination of permeability to water [of vegetable tissue]. Effect of hydrogen ion concentration on water uptake. H. Drawert (*Planta*, 1954, **44,** 1—8).—Deplasmolytic determinations of water uptake by the outer and inner epidermal layers of the scale-leaves of *Allium cepa* confirm the conflicting data in the literature with respect to the effect of the pH of the deplasmolysing medium. According to the "physiological state" of the cells, min. uptake may occur at pH 4—5, and max. at pH 6—8, or *vice versa*. A tentative explanation for these results is offered. P. S. ARUP.

Foliar spray application of phosphates. J. Karlovsky (*N.Z. J. Agric.*, 1954, **88,** 74).—Pasture plants absorbed various phosphates (with other nutrients) sprayed on to foliage, but resulting yields were no greater than when equivalent amounts of nutrients were applied as a fertiliser top-dressing, although the soil used had a high fixing capacity for PO_4'''. A. G. POLLARD.

Biochemistry of the photoperiodic response: the high-intensity light reaction. J. L. Linerman and J. Bonner (*Bot. Gaz.*, 1953, **115,** 121—128).—To induce flowering in a "short-day" plant a long dark period must be preceded by exposure to a period of high light intensity. This period may be replaced by application, to leaves and stems, of sugars or of intermediates of the Krebs cycle. Distinction is drawn between the mechanism of the high-intensity light effect and the low-intensity effect which inhibits floral induction.
A. G. POLLARD.

[Connexion between] day-length, leaf-growth, and flowering. E. Bünning and M. Konder (*Planta*, 1954, **44,** 9—17).—For the long-day plant *Plantago lanceolata* as well as for the short-day plants *Amaranthus caudatus* and *Perilla ocymoides*, long-day, as compared with short-day conditions shorten the life-period of the leaves; the short-day plants, however, produce a greater area of leaf-surface under long-day than under short-day conditions, whereas the opposite holds for the long-day plant. The length of life of the leaves and the total leaf-surface developed are considered as possible controlling factors with respect to flowering. P. S. ARUP.

Effect of relative variations in periods of light and darkness on phosphatase-activity in leaves of *Kalanchœ blossfeldiana*. M. Ehrenberg (*Planta*, 1954, **43,** 528—536).—Under a' 12-12-hr. alternation of light and darkness, min. and max. phosphatase activities coincide with the beginning and end of the light period. Under 8–16-hr. and 18 : 6-hr. rhythms, the 12-hr. difference between the max. and min. activities persists, but under the 8–16-hr. rhythm the max. shifts towards the middle of the light period, whilst under the 18–6-hr. rhythm, the min. occurs at the beginning of the light period.
P. S. ARUP.

Photoreduction by *Chlamydomonas*. A. W. Frenkel and R. A. Lewin (*Amer. J. Bot.*, 1954, **41,** 586—589).—*Chlamydomonas* is rapidly adjustable to a metabolism involving molecular H_2. A phosphate buffer at pH 5·6 is more suitable than a bicarbonate buffer at pH 9·0, higher rates of photoreduction being obtained. In acid phosphate the max. rates of photoreduction are approx. 10 cu. mm. H_2/hr./cu. mm. of cells. Photoreduction quotients (H_2/CO_2) are in agreement with val. for other organisms, and max. rates are similar to those for *Chlorella* and *Euglena*. T. G. MORRIS.

Possible function of vitamin K in photosynthesis. J. S. C. Wessels (*Rec. Trav. chim. Pays-Bas*, 1954, **73,** 529—536).—A review of the literature and recent experimental evidence support the theory that vitamin K (**I**) functions as H-donor and energy acceptor in photosynthesis. Since the value of E_0' is −25mv. at pH 6·5, **I** should behave as an oxidant in the Hill reaction involving photochemical reduction by chloroplasts (*idem, ibid.*, **71,** 809; **72,** 1076). Probably there is a transfer of a H-atom from chlorophyll at $C_{(10)}$ to the O-atom of **I**, the resultant free radicals reacting with water to yield reduced **I** and O_2. The action of a no. of inhibitors (NH_2OH, 2 : 4-dinitrophenol, dicoumarol, thymol, certain narcotics, etc.) on the Hill reaction is explained by this theory and is confirmed by measurements of the fluorescence of chloroplasts in presence or absence of benzophenone. Narcotics and NH_2OH increase the fluorescence yield of chloroplasts since they inhibit transfer of excitation energy from chlorophyll to **I**, whereas naphthaquinones, phthiocol and 2 : 4-dinitrophenol decrease the fluorescence yield because they can take the place of **I** on the chlorophyll and enzyme surface and are energy acceptors. The concn. ratio of chlorophyll to **I** is ~200 which makes an efficient energy-transfer just possible. A probable function of **I** during oxidative phosphorylation is also suggested. W. J. BAKER.

Mode of action of streptomycin on formation of chloroplasts. M. De Deken-Grenson (*Arch. int. physiol.*, 1954, **62,** 290—292).—Streptomycin (SM) inhibits growth and prevents development of

chloroplasts in barley seedlings. The plants are white and devoid of leucoplasts. Respiration is normal, but ribonucleic acid and protein synthesis is inhibited and free amino-acids accumulate. The effects are reversible, but with large doses of SM persist for a long time after transplanting into a SM-free medium.
M. E. NUTT.

Nitrogen fixation and photo-production of molecular hydrogen by *Thiorhodaceæ*. J. W. Newton and P. W. Wilson (*Antonie van Leeuwenhoek*, 1953, **19**, 71—77).—Two strains of the purple bacterium, *Chromatium* sp., produced H_2 when supplied with DL-malate and HCO_3' in light and in absence of exogenous NH_3 and N_2. SOILS & FERT. (A. G. P.).

Ammonium and nitrate nitrogen absorption by citrus. A. Wallace (*Soil Sci.*, 1954, **78**, 89—94).—Lemon cuttings were grown in soil of low org. matter and N content, treated with NH_4NO_3 in which the NH_4 portion contained ^{15}N. At the end of growth total N, NO_3' and ^{15}N were determined in the plant material, and total N, ^{15}N as NO_3' and NH_4'-N extractable by N-NaCl in the soil. Similar experiments were made using orange cuttings in soil and sand cultures. The N content of the cuttings increased and the percentage of N recovered decreased, with increasing N treatment. At all levels more NO_3'-N was absorbed than NH_4'-N. Of the added N, 22—52%, depending on the rate of application, remained in the soil as NO_3'-N and NaCl-extractable NH_4'-N. Some was fixed as unexchangeable NH_4'-N in org. matter. Little N was lost from the soil. NH_4'-N was absorbed more rapidly from sand or solution cultures than from soil. T. G. MORRIS.

Plant mineral nutrition. II. Absorption of iron and manganese by dwarf kidney bean, tomato, and onion from culture solutions. W. Leach and C. D. Taper (*Canad. J. Bot.*, 1954, **32**, 561—570).—The Fe : Mn ratio in the solution must be 1·5—3·0 for dwarf bean, or 0·5—5·0 for tomato, if deficiency symptoms of either Fe or Mn are to be avoided. Concn. of both Fe and Mn below the min. produce deficiency symptoms irrespective of the Fe : Mn ratio. When onion is grown, the combined amount of Fe + Mn absorbed remains constant, irrespective of the Fe : Mn ratio. R. H. HURST.

Iron chelates for the control of lime-induced chlorosis in fruit. C. Bould (*A.R. agric. hort. Res. Sta. Bristol*, 1953, 91—95).—Soil treatment with Fe ethylenediaminetetra-acetate (EDTA) (5—30 g. Fe per bush or tree) had no effect on the severity of chlorosis of foliage of red currants, pears, or plums growing on calcareous soils. Red currants gave a slight response to foliage sprays (0·125—0·5% NaFe-EDTA). Leaf damage generally developed in pear and plum sprayed with 0·125% solutions. Trunk injections with Fe-EDTA were not as effective as were equiv. rates of $FeSO_4$.
A. H. CORNFIELD.

Vermiculite-carried chelates. Anon. (*Farm. Chem.*, 1954, **117**, No. 7, 36).—The Fe chelates are sprayed on to vermiculite (22—70 mesh) which is subsequently dried. The product, used for correcting Fe chlorosis in plants, may be applied directly to the soil alone or mixed with fertiliser. A. G. POLLARD.

Relationship between nickel toxicity and iron supply. W. M. Crooke, J. G. Hunter, and O. Vergnano (*Ann. appl. Biol.*, 1954, **41**, 311—324).—Nickel toxicity symptoms (necrosis and chlorosis) in oats grown in sand- and water-culture were less severe with high than with low concn. of Fe in the nutrient solution. Uptake of Ni was reduced by increasing the Fe concn. of the solution; increasing the Ni concn. of the solution reduced Fe uptake, but the effect was not as great. With constant Fe supply uptake of Ni increased with the pH of the nutrient solution, although the extent of necrosis was similar over the pH range 4 to 7. With const. Fe supply the P content of the stem was correlated with degree of Ni toxicity.
A. H. CORNFIELD.

Effect of magnesium sulphate on the rate of absorption of urea by tomato leaves. J. Montelaro, C. B. Hall, and F. S. Jameson (*Proc. Amer. Soc. hort. Sci.*, 1953, **62**, 363—366).—The addition of $MgSO_4$ to aq. urea sprays applied to tomatoes reduced the absorption of urea by the tomato leaves. L. G. G. WARNE.

Effect of Mg, K, Fe, and Be on growth and biochemical processes of flax and barley, under conditions of boron deficiency. N. V. Kovaleva and M. Yu. Shkol'nik (*Dokl. Akad. Nauk SSSR*, 1954, **96**, 837—840).—Deficiency of B in the nutrient solution fed to barley seedlings is compensated by raising the Mg, K, Fe, or Be content of the solutions. At the same time normal levels of catalase, peroxidase. and iodine-reducing activities, and of reduced ascorbic acid, are restored in both barley and flax. Addition of MnO_2 has a similar effect. R. TRUSCOE.

Molybdenum requirements of tomato plants given different types of nitrogen supply in sand culture. E. J. Hewitt and C. C. McCready (*A.R. agric. hort. Res. Sta. Bristol*, 1953, 209—213).—Growth of tomatoes was reduced by Mo deficiency with all N sources; the reduction was greatest where NO_3' was supplied. Total chlorophyll content was markedly decreased where NO_3' was supplied. Ascorbic acid and dehydroascorbic acid were decreased by Mo deficiency with all N sources. In Mo-deficient plants marked NO_3' accumulation occurred when NO_3' or NH_4NO_3 was supplied. The N × Mo interactions were significant with respect to all values measured. A. H. CORNFIELD.

Polyuronide fraction and soluble and insoluble carbohydrates of orange peel. W. B. Sinclair and P. R. Crandall (*Bot. Gaz.*, 1953, **115**, 162—173).—Data for Valencia orange peel and for the albedo of navel oranges shows the uronide content of the fraction insol. in 80% of EtOH, and that of related constituents. A. G. POLLARD.

Amino-acids in legume nodules: chromatographic study. S. P. Sen and D. P. Burma (*Bot. Gaz.*, 1953, **115**, 185—190).—The NH_2-acids present in the nodules and in the root tissue of four species of legumes are examined chromatographically. No qual. differences between nodules and root tissue in this respect were apparent. Plants receiving elementary N_2 and those given fixed N yielded similar data. Some differences in the proportions of certain unidentified constituents of roots and nodules are indicated.
A. G. POLLARD.

Growth and inhibition of isolated plant parts. IV. Action of hexose phosphates on *Avena* coleoptile sections. K. V. Thimann and E. Marré (*Amer. J. Bot.*, 1954, **41**, 556—560).—The growth of cut sections of *Avena* coleoptile in the presence of auxin was not stimulated by the presence of hexose phosphates such as glucose-1-phosphate, glucose-6-phosphate, fructose-6-phosphate, or fructose-1 : 6-diphosphate in concn. which for sucrose or glucose are highly effective; a concn. of >0·01M. caused slight inhibition due to osmotic effects. Growth was inhibited by phloridzin independently of sugar uptake, the effect being the same whether the phloridzin is applied simultaneously with sucrose or after. The inhibition is not reversed by hexose phosphate. T. G. MORRIS.

Method of expressing composition of plant tissues. J. C. Cain, W. C. Jacob, W. Reuther, J. G. Sealey, C. B. Shear, and G. F. Potter (*Proc. Amer. Soc. hort. Sci.*, 1953, **62**, xxii—xxiv).—A report of a committee on mineral-deficiency diagnosis which gives a table for the calculation of molar and equivalent concn. of N, P, K, Ca, Mg, Na, Cl, S, Al, B, Co, Ca, Fe, Mo, and Zn from the % and/or p.p.m. of these elements in plant tissues. L. G. G. WARNE.

Seasonal variation in combined L-fucose content of common British Laminariaceæ and Fucaceæ. W. A. P. Black (*J. Sci. Food Agric.*, 1954, **5**, 445—448).—The L-fucose (**I**) content decreases with depth of immersion from 13% in *Pelvetia canaliculata* to <4% in the Laminariaceæ (*L*) (dry basis). In *L* **I** content is always higher in the frond than in the stipe, variations in one part being reproduced in the other. Generally **I** is a min. in March–April and accumulates as photosynthesis proceeds as does mannitol. In the Fucaceæ, **I** content shows no regular seasonal variation on the dry basis, but considerable differences occur between species. On the wet basis marked seasonal variations occur, mainly due to water uptake by the plant before sporing. S. C. JOLLY.

Carotene, carotenoid, and chlorophyll contents of some Scottish seaweeds. E. C. Owen (*J. Sci. Food Agric.*, 1954, **5**, 449—453).—Carotene (**I**) is more abundant than are xanthophylls (**II**) in brown algæ; red and green algæ, like land plants, have less **I** than **II**. The ratios of **II** to **I**, and of total chlorophyll (**III**) to total carotenoids (**IV**) in the algæ are similar to ratios calculated from the data of Seybold and Egle (*Jb. wiss. Bot.*, 1938, **86**, 50), although concn. of both **III** and **IV** were lower than were those reported by these authors. Marine algæ, like land plants, contain amounts of **IV** that are related much more nearly to the amount of **III** than to the major constituents of the plants' dry matter. S. C. JOLLY.

Auxin polarity in the *Coleus* plant. A. C. Leopold and F. S. Guernsey (*Bot. Gaz.*, 1953, **115**, 147—154).—A method for determining auxin (sensitive to 10^{-11}M.), using pea root tips, is described. In vegetative stems of *Coleus* there is a strict basipetal polarity from stem apex to root tip. In flowering stems no strict polarity gradient occurs; auxin may be translocated in either direction. A diffusible substance occurring in the flowering apex and causing an incomplete polarity characteristic in the stem, is postulated. Intact flowering stems transport, acropetally, the substance which stimulates the phototropic response: vegetative stems lack this ability. A. G. POLLARD.

Ethylene-induced polarity alterations in plant cells. E. Bünning and H. Ilg (*Planta*, 1954, **43**, 472—476).—Histological changes in shoots of *Vicia faba*, exposed to an atm. containing 1% of C_2H_4, include the formation of two endodermal layers, one of which lies between the stele and the inner portion of the medulla, and also of a radially disposed fibrous pericycle tissue. Cutinisation and cell-proliferation in the endodermal layers are probably largely due to these observed changes in cell-polarity. P. S. ARUP.

Effectiveness of ethylene for ripening tomatoes. P. H. Heinze and C. C. Craft (*Proc. Amer. Soc. hort. Sci.*, 1953, **62**, 397—404).—Fruits of Rutgers tomato were picked in the " mature green " condition. Their rate of ripening when in small closed containers was not affected by additions of ethylene. When emanations were removed by ventilation, additions of ethylene accelerated ripening but only to the level shown by the fruits in the closed containers without ethylene addition. Ripening tomatoes evolve ethylene at a rate of up to 0·4 mg. per kg. of fruit per 24 hours. L. G. G. WARNE.

Comparative effects of certain chemicals on *Tradescantia* chromosomes as observed at pollen tube mitosis. H. H. Smith and T. A. Lofty (*Amer. J. Bot.*, 1954, **41**, 589—593).—Pollen grains of *Tradescantia paludosa* were harvested, dried for 6 hr., treated with ethylene oxide, methyl chloride, or ketene and then sown in a culture medium and incubated at 20° until a no. of the metaphase stages of the dividing generative nuclei were present. Controls were treated with known amounts of a specified u.v. light. Both ethylene oxide and ketene produced chromatid breaks, the most effective treatment produced 5·21 and 3·52% aberrations with ethylene oxide and ketene respectively. Methyl chloride caused a higher percentage of breaks (max. 4·04) but did not produce erosions or contractions. T. G. MORRIS.

Effect of selected chemicals on the alkaloidal yield of *Datura tatula*, L. J. L. Beal, B. V. Christensen, and A. B. Colby (*J. Amer. pharm. Ass.*, 1954, **43**, 282—287).—Under field conditions, naphthoxyacetic acid was applied to the soil and Zn-insulin and diethylstilbœstrol sprayed on foliage. Both test solutions and controls contained 1% Tween as a spreading agent. The naphthoxyacetic acid-treated plants contained more alkaloid at the third harvest than did the control; Zn-insulin, but not diethylstilbœstrol, also appreciably affected the % of alkaloids. J. CALEY.

Gross effects of growth-inhibiting levels of tritium oxide on *Chlorella pyrenoidosa*. J. W. Porter and M. S. Watson (*Amer. J. Bot.*, 1954, **41**, 550—555).—Growth of *Chlorella pyrenoidosa* in an inorg. nutrient was inhibited by ^3H_2O to extents which increased with the dose of radiation. The inhibiting effect of 5 mc./ml. of ^3H_2O persisted into the first subculture in non-radioactive nutrient while that of 15 mc./ml. did not disappear until the third subculture. The no. of *Chlorella* cells formed in the presence of ^3H_2O and in subcultures was an inverse function of the dose of radiation received by the cells. The diameter of cells grown in radioactive media was slightly larger than normal. Only 27% of irradiated cells were able to form colonies on inorg. nutrient agar, but these cells died after plating and not before. Colonies growing from the plated cells were abnormal in colour and size. T. G. MORRIS.

Adaptive formation and physiological significance of indolylacetic acid oxidase. A. W. Galston and L. Y. Dahlberg (*Amer. J. Bot.*, 1954, **41**, 373—380).—In rapidly-growing root, stem, and bud tissues of etiolated pea plants the activity of indolylacetic acid oxidase is very low; it is somewhat higher in slow-growing tissue and highest in old tissue incapable of growth. The ageing of plant cells is associated with increasing production of the oxidase which, in turn, is a response to high concn. of auxin. A. G. POLLARD.

Rôle of the *ortho* position in the benzoic and aryloxyalkanecarboxylic acid plant-growth regulators. J. Grundy (*Chem. & Ind.*, 1954, 1071—1072).—The activity of plant-growth regulators in the aryloxyalkanecarboxylic acid series (**I**) apparently necessitates a free *ortho* position. This does not apply to the actual 2 : 6-disubstituted benzoic acids. Halogeno-benzoic acids have, however, a high specific activity associated with the *ortho* position since they react readily, in the presence of various metal ions, with a nucleophilic reagent eliminating halogen and attaching the nucleophilic species at the *ortho* position. The benzoic series of plant-growth regulators probably function in this way using trace metals in the plant. If the *ortho* position in **I** fulfils the same function as that suggested for the benzoic acids then *ortho*-activation must occur, but not of the type present in the benzoic acids. *Ortho*-activation in **I** can arise by the effect of substituents. R. J. MAGEE.

Hormone sprays. K. L. J. Blommaert (*Fmg S. Afr.*, 1954, **29**, 295—296).—Tabular results of the effects of naphthylacetic acid and -amide sprays upon the thinning of Golden Delicious and Ohenimuri apples at blossom time are recorded. E. G. BRICKELL.

Growth substances as fruit-thinning agents for apples. D. L. Abbott (*A.R. agric. hort. Res. Sta. Bristol*, 1953, 58—63).—There were varietal differences in response of three varieties of apple to the fruit-thinning action of α-naphthylacetic acid (**I**) (2—100 p.p.m. sprays applied 8—9 days after petal fall). There was an approx. log. relationship between concn. of **I** and its thinning effect. The treatments reduced the size of marketable crop. Conditions favouring the availability of nutrients to the developing fruitlets minimise the thinning effect of **I**. A. H. CORNFIELD.

Struggle against the alternation of the bearing of fruit trees by chemical thinning. W. Wurgler, P. Aubert, J. Charrière, and A. Dufour (*Rev. romande Agric., Vitic. Arboric.*, 1954, **10**, 32—34).—The application of α-naphthylacetic acid (in prep. such as Dirigeol, Frufix A) at the time of petal fall or 15 days later, determines the thinning of the crop, and improves the quality of the ripe fruit. It does not appear to interfere with the subsequent storage properties of apples. Used in suitable concn., the above prep. cause a break in the alternation of Belle de Boskoop and varieties of Reine de Reinette. However, some trees react unfavourably to the treatment, depending on the health of the tree and the soil.
FOOD SCI. ABSTR. (R. B. C.).

Hormone effect on tomatoes grown in nitrogen-rich soil. C. S. Parsons and E. W. Davies (*Proc. Amer. Soc. hort. Sci.*, 1953, **62**, 371—376).—Tomatoes in a soil containing 0·045% N were given adequate supplies of K and P, and added N at the rates of 0, 50, 150 (in one or two applications) or 300 (in two or four applications) lb. per acre. With no hormone sprays most N-levels gave higher yields than did the control but medium N-supplies gave no better yields than were obtained with 50 lb. N per acre and 300 lb. of N (in four applications) reduced yields to the level of the control. With hormone sprays all levels gave higher yields than the control (no N, no hormone). L. G. G. WARNE.

Influence of growth regulator sprays on the growth, respiration, and ripening of Bartlett pears. F. W. Allen (*Proc. Amer. Soc. hort. Sci*, 1953, **62**, 279—298).—Developing pear fruits were sprayed with naphthylacetic acid (10 to 50 p.p.m.) 2 : 4-D (1—5 p.p.m.), *p*-chlorophenoxyacetic acid (20—50 p.p.m.), 2 : 4 : 5-T (20—50 p.p.m.), and 2 : 4 : 5-trichlorophenoxypropionic acid (15—100 p.p.m.). The general effect of the sprays was to accelerate ripening after picking without affecting final fruit size. Accelerated ripening did not always occur with fruit harvested early. Later harvesting of sprayed fruit showed generally either at picking or subsequently in store premature ripening, and later, break down. Generally, sprayed fruit was softer and had a higher respiration rate than unsprayed fruit. With very high concn. of growth substance (100 and 500 p.p.m. for 2 : 4 : 5-trichlorophenoxy-propionic and -acetic acids, respectively) fruit was often full yellow and broken down at normal picking time. L. G. G. WARNE.

2 : 4 : 5-Trichlorophenoxypropionic acid [TP] as a fruit-ripening agent. I. Apple var. Worcester Pearmain. D. L. Abbott (*A.R. agric. hort. Res. Sta. Bristol*, 1953, 53—57).—Spraying Worcester Pearmain with 2 : 4 : 5-TP (30—50 p.p.m.) on 15 July or 4 August produced ripe fruit of good quality 12 days before the control. Marketable fruit, though of poorish size and flavour, was produced 20 days before the control. The treatment impaired the storage quality of the fruit. A. H. CORNFIELD.

Strengthening of cereal stalks by application of 2 : 4-dichlorophenoxyacetic acid (2 : 4-D). S. M. Mashtakov, S. M. Gol'dina, and R. I. Prokudina (*Dokl. Akad. Nauk SSSR*, 1954, **96**, 845—848).—Spraying of oat seedlings with 2 : 4-D (1 kg./ha.) causes shortening and strengthening of the stalks, and raises the yield of grain. The effects may be due to better illumination of the growing plants, as a result of suppression of weeds and of formation of narrower and stiffer oat leaves. R. TRUSCOE.

Comparative effects of catechol, some related compounds, and other chemicals on suberisation of cut potato tubers. A. O. Simonds, G. Johnson, and L. A. Schaal (*Bot. Gaz.*, 1953, **115**, 190—195).—Treatment of cut surfaces of the tubers with dihydric phenols and related substances (catechol, 4-chlorocatechol, protocatechuic aldehyde, caffeic acid, D-catechin, dihydroxyphenylalanine, chlorogenic acid, but not protocatechuic acid) stimulated wound healing and the formation of thicker suberised layers, the relative effects of the substances diminishing in the order named. Resorcinol inhibited suberisation, probably through its action on tyrosinase.
A. G. POLLARD.

Growth-controlling effects of some quaternary ammonium compounds on various species of plants. P. C. Marth, W. H. Preston, jun., and J. W. Mitchell (*Bot. Gaz.*, 1953, **115**, 200—204).—Soil in which bean plants were growing was treated with (4-hydroxy-5-*iso*propyl-2-methylphenyl)trimethylammonium chloride, 1-piperidine carboxylate (Amo 1618). The compound was absorbed by the plants and translocated to stems, leaves, and seeds. Treated plants developed shorter nodes, thicker stems, and darker leaves than normal. At the rate of 10 and 100 lb. per acre Amo 1618 maintained its action undiminished during a three-year period. Seed from treated plants showed the effects of the treatment to diminishing extents over two further generations. Responses of 43 species of plants to the treatment varied considerably. Seven new quaternary NH_4 compounds inhibited the elongation of plant nodes. A. G. POLLARD.

Biological action of mustards on dormant seeds of barley and wheat. J. MacKey (*Acta agric. scand.*, 1954, **4**, 419—429).—Dormant wheat seeds were treated with variable amounts of N mustard [methylbis-(2-chloroethyl)amine hydrochloride] or with mustard gas for 40 minutes at 21—22°. Washing after treatment affected the resultant germination. 10% of the seeds germinated in sand following washing for 10 minutes after treatment whilst none germinated if washed for only 0·5 minute. Similarly other treatments favouring diffusion of the mustards, *e.g.*, long storage, high temp., embedding in absorbent material, increased the germination. The toxicity of the mustards overshadows their ability to induce heritable mutations, but the effect is noticeable. Significant differences are observed between the ability of mustards and radiations to produce chlorophyll mutations. T. G. MORRIS.

Occurrences of anti-bacterial substances in seed plants with special reference to *Mycobacterium tuberculosis*. IV. A. Frisbey, R. Y. Gottshall, J. C. Jennings, and E. H. Lucas (*Mich. agric. Exp. Sta. Quart. Bull.*, 1954, **36**, 477—488; cf. *ibid.*, 1953, **35**, 392).—Among species from 82 families of plants examined, those from 52 families yielded extracts having antibacterial activity. Active principles from 123 species inhibited the growth of *M. tuberculosis, in vitro*; 44 of these were specific in their action. Antibacterial effects on *Micrococcus pyogenes* var. *aureus* were shown by many and on *Salmonella typhi-murium*, and *Escherichia coli* by a few species. A. G. POLLARD.

Use of maleic hydrazide as a sprout inhibitor for onions. D. R. Paterson and S. H. Wittwer (*Proc. Amer. Soc. hort. Sci.*, 1953, **62**, 405—410).—Two to five lb. of maleic hydrazide per acre given as a spray (1000 or 2000 p.p.m.) to onions 2, 11, or 29 days before harvest reduced sprouting and root growth in store. Sprays given 29 days before harvest tended to increase the incidence of bulb damage in store. L. G. G. WARNE.

Response of Kennebec potatoes to maleic hydrazide. E. L. Dennison (*Proc. Amer. Soc. hort. Sci.*, 1953, **62**, 411—421).—Potatoes were sprayed at pre bloom, full bloom, or post bloom (eight days after full bloom) with maleic hydrazide (375—6000 p.p.m.). At the higher concn., for the earlier sprays leaf curling, chlorosis, and stem growth inhibition occurred and aërial tubers were produced. The early sprays resulted in a greatly decreased yield but the latest spray did not have this effect. Early sprays especially at high concn. resulted in tubers with skin cracks and secondary growth. Later sprays were less detrimental. Sprays given five weeks before harvest (500—1500 p.p.m.) did not affect yields. Tubers from the treated plots sprouted almost as rapidly as the controls but the sprouts were in the form of rosettes and did not elongate. L. G. G. WARNE.

Effects of maleic hydrazide and its derivatives on yields and storage properties of potatoes. R. Longchamp and R. J. Gautheret (*Ann. Agron.*, 1954, **5**, 207—224).—The effects of foliage applications of maleic hydrazide (**I**) and certain of its derivatives on yields, quality, and sprouting of tubers during storage were studied. Yields were somewhat reduced by some of the treatments on some application dates. The heaviest application (10 kg. of **I** equiv. per hectare) caused the greatest yield reductions and produced a poor quality tuber; this was more marked where **I** than where the methylamine or diethanolamine (**II**) derivatives of **I** were used. With applications exceeding 3 kg. per hectare all treatments effectively reduced sprouting during storage, although **II** was not as effective as were the other materials in this respect. Even the heaviest dressing of **I** did not affect the culinary properties of the tubers. The effects of the treatments on the morphology and chemical composition of the tubers are reported. A. H. CORNFIELD.

Effect of phosphorus smoke on plants. T. V. Voblikova (*Dokl. Akad. Nauk SSSR*, 1954, **96**, 833—835).—The yield of beans is raised, and the growth of the leaf and stem systems is stimulated, and of the root system depressed, after treatment, as an anti-frost measure, with smoke produced by burning red P. The effects are ascribed to assimilation by the leaves of H_3PO_4 from droplets settling on them. R. TRUSCOE.

Cytogenetics of the vegetable crops. I. Monocotyledons. S. H. Yarnell (*Bot. Rev.*, 1954, **20**, 277—359).—A review with an extensive bibliography (432 references). L. G. G. WARNE.

Double backcrossing as a possible method of developing an early large-fruited tomato. C. Walkof (*Dissert. Abstr.*, 1954, **14**, 1126).—The early, small-fruited Farthest North and the late, large-fruited Early Jersey varieties were used for the initial cross. Two of the largest-fruited plants from the Farthest North backcross and two of the earliest plants from the Early Jersey backcross were selected, and the progenies of the selfed and backcrossed selections are discussed. The combinations of earliness with small fruit size and lateness with large fruit size in the parents seem to be representative of most tomato varieties; this suggests a genetic basis for each combination. The correlation data obtained from the generations studied seemed to agree in general with this relationship. E. M. J.

Effect of lodging on spring oat yields and test weight. J. W. Pendleton (*Agron. J.*, 1954, **46**, 265—267).—All the artificial lodging treatments imposed reduced both yields and test wt. of the grain. These reductions were greater when lodging occurred four days after than when it occurred 20 days after heading. Reductions were also proportional to the extent of lodging. A. H. CORNFIELD.

Protein content of autumn-sown oat varieties. G. K. Middleton, F. A. Coffman, J. G. Moseman, and F. J. Bell (*Agron. J.*, 1954, **46**, 282—284).—There were highly significant differences due to variety and location in the protein content of 15 varieties of oats grown at nine south-eastern (U.S.) locations. With 70 varieties and strains of the World Oat Collection, grown at three locations in N. Carolina in 1952—3, there were significant differences in protein content between varieties but not between locations. A. H. CORNFIELD.

Effect of date of planting and clipping on oat forage and grain yields. L. V. Crowder (*Agron. J.*, 1954, **46**, 154—157).—Oats sown in Aug. and Sept., but not those sown in Oct., produced sufficient forage for autumn and winter grazing. Dry matter production of autumn forage ranged from 90 to 910 lb. per acre. There were varietal differences in yields of forage. Oct.-planted oats gave higher yields of spring forage than did Aug.- or Sept.-planted oats. Autumn and winter forage contained 30%, whilst spring forage contained 12%, of protein. Both grain and straw yields were reduced by clipping 2—3 times during the growing season, but the value of the forage obtained generally compensated for the loss of the grain. A. H. CORNFIELD.

Identification of threshed barley. (*Muntona Ltd.*, 1954, 18 pp.).—Descriptions are given of morphological features used in identification and of the characteristics of 15 common varieties; distinguishing features are tabulated and depicted. P. S. ARUP.

Seed production of Russian wild rye. R. E. Stitt (*Agron. J.*, 1954, **46**, 171—175).—Under irrigation row spacings of 1·5—2 ft. gave high seed yields when 100—200 lb. of N per acre was applied. Response to N occurred only in the year after application, and inorg. N was more effective than org. N. Under dryland conditions the highest yields were obtained with row spacings of 6—10 ft. and 100 lb. N per acre. A. H. CORNFIELD.

Photoperiodic response in early varieties of rice. G. Misra (*Curr. Sci.*, 1954, **23**, 233—234).—The photoperiodic response is determined for two early varieties of rice when subjected to 10-hr. short days for one month. Short-day photoperiod delays the first panicle emergence in both varieties when applied to seedlings 10 days old, but the effect lessens when the treatment is applied to older seedlings. The treatment also extends the time taken for flowering until the emergence of ears, but again the effect decreases with seedling age. L. F. TAYLOR.

Design of simplified equipment for the rapid determination of the moisture content of grain and forage crops. G. W. Isaacs (*Dissert. Abstr.*, 1954, **14**, 1118).—Details are given of two methods. The exhaust oven method uses the heat from the exhaust gases of an internal combustion engine. These gases are mixed with air to lower the temp. and prevent burning of the sample. Hay (100—200 g.) may be dried in about 7 min. and samples of grain in about 15 min. The electrical resistance method depends on testing the electrical resistance of hay and grain, using resistance-type moisture meters. An automatic averaging device gives a single indication of the average moisture content of a large no. of samples. The average electrical conductivity of the samples indicates a close approximation of their average moisture content. Other methods are discussed. E. M. J.

Effects of nitrogen fertilisation, plant spacing, and variety on the protein composition of maize. A. B. Prince (*Agron. J.*, 1954, **46**, 185—186).—Increased applications of N to the soil resulted in increased contents of crude protein, zein, and leucine and decreased content of isoleucine in maize grain. Increasing the plant population had the reverse effect. There were varietal differences in the leucine, *iso*leucine, and tryptophan contents of the grain. A. H. CORNFIELD.

Crude protein of maize grain and stover as influenced by different hybrids, plant populations, and nitrogen levels. M. S. Zuber, G. E. Smith, and C. W. Gehrke (*Agron. J.*, 1954, **46**, 257—261).—The application of 50 lb. of N per acre depressed, whilst that of 120—250 lb. increased, the crude protein % in maize grain. The protein % in the grain decreased with increasing plant population. Application of N greatly increased, whilst plant population had

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little effect on, the protein % in the stover. There were significant differences in response of different hybrids to N applications in both years. A. H. CORNFIELD.

Yield and protein content of silage maize as influenced by fertiliser application. K. E. Harshbarger, W. B. Nevens, R. W. Touchberry, A. L. Lang, and G. H. Dungan (*J. Dairy Sci.*, 1954, **37**, 976—981).—Application of commercial fertilisers to soil used for maize forage resulted in (i) an increased wt. of forage, (ii) little change in the % of ears, or in the protein content of the grain except as influenced by season, and (iii) an increased protein content of leaf-stalk fraction on soils low in available plant food. S. C. JOLLY.

Machine for sampling ear maize for moisture determinations. C. E. Brown, sen., and E. C. Rossman (*Agron. J.*, 1954, **46**, 240).—The machine is described. A. H. CORNFIELD.

Nutrient levels and yields of Netted Gem potatoes as influenced by nutritional treatment on various soil types. C. A. Eaves and J. S. Leefe (*Proc. Amer. Soc. hort. Sci.*, 1953, **62**, 377—383).—Potatoes on three soil types received either 500, 1000, 2000, or 4000 lb. per acre of 20% superphosphate and 166 or 500 lb. per acre of 60% KCl. All plots received 500 lb. of $(NH_4)_2SO_4$ per acre. On all soils the level of superphosphate supply was reflected in the amount of sol. P and of Ca in the tissue but this was not related to yield. Increased K supplies caused an increased K content in the tissue and this was related to an increased yield. L. G. G. WARNE.

Effect of various environmental factors on the suitability of potatoes for chip-making. D. K. Salunkhe, E. J. Wheeler, and S. T. Dexter (*Agron. J.*, 1954, **46**, 195—199).—The effects of 3—4 dates of planting and different fertiliser and irrigation treatments on sp. gr. and chip colour rating of several varieties of potato over three years at two locations were studied. Chip colour rating and sp. gr. were correlated within a variety for any one day of planting. Potatoes from early-planted plots gave lighter-coloured chips for any sp. gr. range than did potatoes of the same sp. gr. from late-planted plots. There was a significant correlation between picric acid colour test for reducing sugars, sp. gr., chip colour, and date of planting for two of the varieties. Location, fertiliser treatments, and irrigation had little effect on chipping quality. A. H. CORNFIELD.

Change in permeability to water of potatoes during storage, and by the action of coumarin. H. v. Guttenberg and G. Meinl (*Planta*, 1954, **43**, 571—575).—Plasmolytic and deplasmolytic experiments on potato discs in 0·5- and 0·2M-mannitol reveal increasing permeability of the tissue to water towards the end of the storage period. Addition of coumarin (10^{-4} g. per ml.) to the deplasmolytic medium markedly counteracts the indications of increased permeability. The observed coumarin-effect is probably unconnected with respiration. P. S. ARUP.

Shortening of the rest period of potatoes. W. van der Merwe, D. G. Wessels, and T. P. Pretorius (*Union S. Afr. Dep. Agric., Agric. Educ. Res. Ser.* 11 ; *Sci. Bull.* 350, 42—47).—Use of 40% ethylenechlorohydrin solution during storage proved advantageous; tops should not be pulled while the plants are immature. E. G. BRICKELL.

Maturity and curing temperatures and their influence on germination of reed canary grass seed. W. L. Griffeth and C. M. Harrison (*Agron. J.*, 1954, **46**, 163—167).—Reed canary grass seed harvested early and dried above room temp. showed poor germination, whilst seed which matured on the plant showed high germination. Seed yields remain relatively const. during the period that seeds in the base of the head are ripening, shattering losses being compensated for by growth of immature seed. Arasan reduced mould development when added to freshly " combined " seed, and had no effect on germination. Ceresan M, Dowicide B, and Actidione reduced germination. A. H. CORNFIELD.

Root penetration, distribution, and activity in Southern grasses measured by yields, drought symptoms, and ^{32}P uptake. G. W. Burton, E. H. DeVane, and R. L. Carter (*Agron. J.*, 1954, **46**, 229—233).—The penetration and activity of the roots of several Southern grasses in a sandy soil was determined by measuring the uptake of ^{32}P from labelled superphosphate placed at varying depths. Of all the grasses the roots of Coastal Bermuda penetrated the soil most rapidly. The highly drought-resistant Coastal and Suwannee Bermuda grasses made better use of fertiliser P than did the other grasses. These two grasses had 65—68% of their roots in the upper 2 ft. of soil, whilst the drought-susceptible carpet grass had 94% of its roots in this layer. Root yields were not correlated with drought-tolerance indices, fertiliser-P uptake, or total N, P, or K removed from the soil. A. H. CORNFIELD.

Molybdenum trials at Invermay. N. A. Cullen (*N.Z. J. Agric.*, 1954, **88**, 241).—Applications of Na molybdate (1—2 oz. per acre) increased the yield of herbage in run-out pasture and markedly increased the development of clover. Response to superphosphate was considerable on plots receiving Mo but not on those treated with lime only. A. G. POLLARD.

Carbohydrates of grasses and clover. VII. Isolation of D-mannitol from perennial rye-grass (*Lolium perenne*). V. D. Harwood (*J. Sci. Food Agric.*, 1954, **5**, 453—455).—D-Mannitol, extracted from the fresh grass, together with much carbohydrate material, by boiling water, can be separated chromatographically on a charcoal column. S. C. JOLLY.

Fungicides for the preservation of moist hay. W. K. Kennedy and R. U. Schenk (*Agron. J.*, 1954, **46**, 252—257).—The application of 2 : 4 : 6-trichlorophenol (10—40 lb. per ton) to moist hay reduced mould growth and dry matter losses during subsequent storage. About half the chemical applied was still present after six months' storage. Cows receiving treated hay showed no abnormal symptoms or decline in milk production, but their milk contained traces of trichlorophenol-like compounds. A. H. CORNFIELD.

Comparison of band sowing and other methods of sowing legumes. M. B. Tesar, K. Lawton, and B. Kawin (*Agron. J.*, 1954, **46**, 189—194).—Band sowing of lucerne and birdsfoot trefoil on the soil surface directly over fertiliser drilled 1·5 in. deep gave better stands, more vigorous plants, and higher utilisation of fertiliser P than did broadcasting over drilled fertiliser. Planting the seed in contact with the fertiliser gave very poor stands. A. H. CORNFIELD.

Influence of legume and fertiliser nitrogen on forage production and botanical composition. R. E. Wagner (*Agron. J.*, 1954, **46**, 167—171).—High yields of forage were produced when orchardgrass or tall fescue were grown with heavy application of N (160—240 lb. per acre) or in association with ladino clover. The grasses growing alone gave poor yields where no N was applied. Ladino clover growing alone, with or without added N, also gave poor yields. The mixed seedlings were superior in distribution of production through the season and contained less weeds than did the pure seedings. A. H. CORNFIELD.

Legume nitrogen versus fertiliser nitrogen in protein production of forage. R. E. Wagner (*Agron. J.*, 1954, **46**, 233—237).—Both orchardgrass and tall fescue gave high annual yields of protein only when fertilised with relatively heavy dressings of N (160—240 lb. per acre). The yields were comparable to those obtained from mixed sowings of the grasses with Ladino clover. However, the distribution of protein production through the season was less satisfactory from the N-fertilised grasses than from the mixed herbage. Bromegrass, with or without added N, gave poor yields of protein. Ladino clover grown alone gave good yields, but when fertilised with N gave poorer yields, probably due to increased weed competition. A. H. CORNFIELD.

Changes in major chemical constituents of subterranean clover (*Trifolium subterraneum*, L.) during growth. I. Carbohydrates. II. Non-carbohydrate fractions and their relation to carbohydrates. N. E. Hardwick (*Aust. J. agric. Res.*, 1954, **5**, 372—382, 383—391).—I. Samples of combined leaf and petiole tissue were cut at intervals during the season. The percentages of free and total reducing sugars, a reserve carbohydrate fraction, celluloses, and hemicelluses, are reported. The amounts of the various constituents were similar to those in other legumes. (29 references.)

II. The same samples were examined for content of lignin, ethanol–benzene extractives, ash, crude protein, and protein. The cellulose : lignin ratio was fairly constant until several weeks prior to wilting, and then decreased. R. H. HURST.

Effect of light conditions on the dry matter yield, dry matter content, and root-top ratio of certain cultivated plants. O. Pohjakallio (*Acta agric. scand.*, 1954, **4**, 189—301).—Experiments with *Phleum pratense, Festuca pratensis, Trifolium pratense, T. hybridium*, winter wheat and rye, and spring wheat, oats, and barley, are described. Increased light favoured dry matter yield and higher content. E. G. BRICKELL.

Effect of heat on impermeable seeds of lucerne, sweet clover, and red clover. C. M. Rincker (*Agron. J.*, 1954, **46**, 247—250).—Dry heating lucerne and red clover seed at 104·4° for 4 min. greatly reduced the no. of hard seeds and greatly increased germination. Hard seed which had been rendered permeable by the treatment produced normal plants. The treatment had little effect on hard clover seed. A. H. CORNFIELD.

Seed production in lucerne as related to nectar production and honeybee visitation. M. W. Pedersen (*Bot. Gaz.*, 1953, **115**, 129—138).—Nectar production per plant is correlated with bee visitation and also with seed production. On the basis of nectar production per flower the correlation was not significant. Applications of this relationship to the breeding of strains of lucerne for high seed yields are recorded. A. G. POLLARD.

Lucerne control methods. W. van der Merwe, D. G. Wessels, and T. P. Pretorius (*Union S. Afr. Dep. Agric*; *Agric. Educ. Res. Ser.* 11; *Sci. Bull.* 350, 8—11).—Fertilisers are best applied during winter (*e.g.*, June) and cutting should not take place later than 15th April. E. G. BRICKELL.

Lucerne irrigation. W. van der Merwe, D. G. Wessels, and T. P. Pretorius (*Union S. Afr. Dep. Agric.*; *Agric. Educ. Res. Ser.* 11; *Sci. Bull.* 350, 49—52).—Highest yields of hay are obtained with low irrigations at short intervals. E. G. BRICKELL.

Carotene: effect of antioxidant on its determination. V. H. Booth (*Analyst*, 1954, **79**, 507—509).—The antioxidant *NN'*-diphenyl-*p*-phenylenediamine (DPPPD) is used, principally in America, to reduce loss of carotene during storage of lucerne meal. Beauchene *et al.* (*J. Agric. Food Chem.*, 1953, **1**, 461) found that more carotene appeared to be present in lucerne meal immediately after treatment with DPPPD than in untreated meal. This interference is not observed when light petroleum is used for extraction and Al_2O_3 for the chromatographic separation instead of the mixture of light petroleum and acetone used for extraction and MgO used for the chromatography by Beauchene *et al.* (*loc. cit.*). The interference appears to be due to the chromogenic reaction observed by Beauchene *et al.* between MgO and DPPPD. A. O. JONES.

Stability of carotene in dehydrated lucerne meal, with effect of antioxidants, oil, and heat. H. L. Mitchell, R. E. Beauchene, and R. E. Silker, (*J. Agric. Food Chem.*, 1954, **2**, 939—941).—Compounds related to aniline showed appreciable protective action in inhibiting the oxidation of carotene in dehydrated lucerne meal during storage; *NN'*-diphenylhexamethylenediamine was the most effective. The effectiveness of the antioxidants was enhanced by heavy oiling of the meal (80 lb. per ton) and by heating the meal at 100° for 1 hr. after spraying with oil. S. C. JOLLY.

Xanthophyll determination in dehydrated lucerne meal. E. M. Bickoff, A. L. Livingston, G. F. Bailey, and C. R. Thompson (*J. Ass. off. agric. Chem., Wash.*, 1954, **37**, 894—902).—The rehydration procedure for the determination of carotene (Bickoff, Livingston, and Van Atta, *ibid.*, 1952, **35**, 826) is applicable to xanthophyll, which is eluted with a mixture of hexane and ethanol. The absorbance of this solution, and of the hexane–acetone eluate of carotene, may be read in a colorimeter with a 440-mμ. filter, or the carotene and xanthophyll may be determined spectrophotometrically at 451 and 445 mμ., respectively. An alternative procedure, employing cold soaking, which avoids loss by oxidation and isomerisation but does not result in complete extraction of the pigments, is a modification of the A.O.A.C. method (Thompson and Bickoff, *ibid.*, 1951, **34**, 219). In replicate analyses, standard deviations for carotene were 2·97, 2·65, and for xanthophyll 10·14, 1·90 for the first and second procedures respectively. A. A. ELDRIDGE.

Magnesium deficiency of apple trees. R. Blanchet (*Ann. Agron.*, 1954, **5**, 119—128).—The leaves at the base of the present year's shoot growth were the most satisfactory for indicating Mg deficiency through chemical analyses. Affected trees responded rapidly to injection with $MgSO_4$. In young trees Mg deficiency affected wood growth more than it did fruiting. Vigour of shoot growth was correlated with Mg content of the shoot but even more closely with the N/Ca ratio of the shoot. Although the content of the individual ions in the shoot varied widely, the sum of the ions (in mequiv.) was relatively const. The Mg content of the shoots was positively correlated with N and P and negatively correlated with Ca content. A. H. CORNFIELD.

Degree of dissociation of acids in the Rome Beauty apple and its relations to number of days from full bloom. D. Comin and D. T. Sullivan (*Proc. Amer. Soc. hort. Sci.*, 1953, **62**, 299—303).—As an index of fruit maturity the quantity of dissociated hydrogen per unit of displaceable hydrogen is suggested. With Rome Beauty apples this index rises to a max. which occurs about 167 days after full bloom. L. G. G. WARNE.

Electrolytic determination of the resistance of fifty-five apple varieties to low temperature. F. H. Emmert and F. S. Howlett (*Proc. Amer. Soc. hort. Sci.*, 1953, **62**, 311—318).—The electrical conductivity of water in which apple twigs subjected to standard low-temp. conditions had been steeped for a standard period was determined. Similar measurements were made after killing these extracted twigs by boiling. Measurements were made in autumn, in early and late winter, and in early spring. Generally the varieties from which the greatest diffusion of electrolytes occurred were these usually considered as tender but there was some interaction of variety and season of testing. L. G. G. WARNE.

Variation between apple fruits and its relation to keeping quality. III. Between-season variation in relation to seasonal climate. D. Martin (*Aust. J. agric. Res.*, 1954, **5**, 392—421).—Most of the changes associated with ripening (ground colour change, acid loss, starch conversion, sol. solids accumulation, softening, and respiration rise) did not necessarily keep pace with each other, and responded differently to seasonal variation. The relation between firmness and acid level was constant. Seasonal variation in the level of disorders was mainly related to differences in mean fruit size. Low temp. in the months prior to harvest increased the susceptibility to breakdown. R. H. HURST.

Perry pears in the West Midlands. I. North-west Gloucestershire. R. R. Williams (*A.R. agric. hort. Res. Sta. Bristol*, 1953, 64—69).—A survey of the perry growing areas is given. A. H. CORNFIELD.

Perry pears and their characters. I. R. R. Williams (*A.R. agric. hort. Res. Sta. Bristol*, 1953, 70—78).—Characteristics of diagnostic value for 13 varieties of perry pear are reported. A. H. CORNFIELD.

Oxidation potentials, buffering, ash, and total solids of peaches. C. E. Blake and R. L. Shirley (*Bot. Gaz.*, 1953, **115**, 180—185).—Fruit from trees grown on sandstone soil showed smaller reducing capacity (ceric sulphate method described), higher oxidation-reduction potential, lower ash content in early growth (but not at maturity) and higher total solids at all growth stages than did that grown on limestone soils. The buffer capacity of the fruit pulp was max. at pH between the initial value and 6·0, min. at pH 6—8 and intermediate at pH 8—10. A. G. POLLARD.

Metabolic differences between leaves of vegetative and flowering branches of lemon grafts. M. Kh. Chailakhyan and T. V. Nekrasova (*Dokl. Akad. Nauk SSSR*, 1954, **96**, 661—663).—The chlorophyll content of leaves from flowering branches was 112% of that of comparable leaves from branches having no flower buds. The corresponding values for other constituents were: starch 37, sugars 76, ascorbic acid 86, peroxidase activity 167%. R. TRUSCOE.

Propagation of gooseberries. I. Factors influencing the rooting of hardwood cuttings. B. A. Rake (*A.R. agric. hort. Res. Sta. Bristol*, 1953, 79—88).—The effects of different methods of preparing and treating cuttings of three varieties of gooseberry on % rooting and vigour are reported. A. H. CORNFIELD.

Seed development in blackberries. E. A. Kerr (*Canad. J. Bot.*, 1954, **32**, 654—673).—Subjects discussed include: seed production and germination, the main steps in megagametophyte development of pseudogamous and syngamous varieties, and the development of both germinable and aborted seeds. The interdependence of material and filial tissues is considered. (23 references.) R. H. HURST.

Salt tolerance of five varieties of onions. L. Bernstein and A. D. Dyers (*Proc. Amer. Soc. hort. Sci.*, 1953, **62**, 367—370).—Onions were irrigated with water (containing initially 450 p.p.m. of salts) to which was added 0, 1000, 2000, or 3000 p.p.m. of a mixture of equal parts of NaCl and $CaCl_2$. At all levels of salt addition yield was reduced (67%, 23%, and 9% of the control at the low, medium, and high salt levels respectively). L. G. G. WARNE.

Propagation by seeds and graftage under fluorescent lamps. V. T. Stoutmeyer and A. W. Close (*Proc. Amer. Soc. hort. Sci.*, 1953, **62**, 459—465).—Cabbage seedlings given illumination rich in red light were less frost resistant than those raised in light rich in blue. Later plantings with no exposure to frost showed no effect. With tomato and pepper seedlings the results were somewhat inconsistent, but generally illumination of seedlings with daylight lamps gave better subsequent field survival than the other types of illumination tried. L. G. G. WARNE.

Correlation of stages of maturity with certain physical measurement in the Southern pea (*Vigna sinensis*). M. W. Hoover and R. A. Dennison (*Proc. Amer. Soc. hort. Sci.*, 1953, **62**, 391—396).—Southern pea seeds were planted on three dates and harvested at two-day intervals from the earliest time when the seeds could be separated from the pericarp. With increasing maturity the moisture content of the seeds decreased, their sp. gr. and the conductivity of their juice increased, whilst the seed content of the fruits increased. The refractive index of expressed juice increased only during the later stages of maturity. L. G. G. WARNE.

[Effects of] variable potassium and magnesium saturation on growth and mineral composition of Bibb lettuce. V. N. Lambeth (*Proc. Amer. Soc. hort. Sci.*, 1953, **62**, 357—362).—Lettuce were grown at K levels of 2·7, 5·4, and 8·1% saturation of the total base-exchange capacity of the soil, at Mg levels of 6·85 and 10·0% saturation, and with N supplies equivalent to 100 or 200 lb. per acre. Yields increased with each increase in K supply and were unaffected by the Mg level, but were depressed by the high N supply at all K and Mg levels. L. G. G. WARNE.

Oil turnips and oil rape. I. Survey of composition in connexion with [cold-]hardening. II. Carbohydrate content in connexion with hardening. N. Hellström (*Acta agric. scand.*, 1954, **3**, 302—310,

311—316).—I. Residues after fat extraction and after extraction with dil. alcohol (*A*), ash, and crude protein (*P*) were determined for two varieties of oil turnips and oil rape. Changes in the amounts of *A* and *P* occur due to hardening, those in *A* (largely due to transformation of polysaccharides into simple sugars) serving as an index of the extent of the hardening process.

II. Significant increase in sugar content due to hardening is reported for oil turnips, Storrybs and Rapido, and for oil rape, Tenus, and Matador. Changes in *P* during hardening are also indicated. E. G. BRICKELL.

Germination of seeds removed from mature and immature butternut squashes after seven months of storage. A. D. Holmes (*Proc. Amer. Soc. hort. Sci.*, 1953, **62**, 433—436).—Seeds removed from immature butternut squashes (*Cucurbita moschata*) after seven-months' storage were smaller than seeds from mature fruits, but showed 77% germination as against 97% for seed from mature squashes. L. G. G. WARNE.

Germination of okra seed as influenced by treatment with acetone and alcohol. W. H. Anderson, R. L. Carolus, and D. P. Watson (*Proc. Amer. Soc. hort. Sci.*, 1953, **62**, 427—432).—Thirty-minutes' immersion of the seed in 95% acetone or ethyl alcohol accelerated emergence, and improved the percentage and uniformity of germination in okra (ladies fingers, *Hibiscus esculentus*). L. G. G. WARNE.

Yield and composition of sorghum juice in relation to time of harvest in Oklahoma. J. E. Webster, D. Benefiel, and F. Davies (*Agron. J.*, 1954, **46**, 157—160).—Values for Brix°, acidity, % ash, N, reducing sugars and sucrose in the juice, % juice in the cane and yields of sugar per acre of eight varieties of sorghum at different dates of harvest over three years are reported. There were wide varietal and seasonal fluctuation in most of the values measured. The % juice in the cane and yields of sugar decreased, whilst acidity of the juice increased, with advancing harvesting date. Total sugars in the juice increased to a max. in the first week in Sept. and then changed little during the rest of the season. A. H. CORNFIELD.

Factors affecting time of planting soya-beans in the Southern States. E. E. Hartwig (*U.S. Dep. Agric.*, 1954, *Circ.* No. 943, 13 pp.).—A study at Stoneville, Miss., with four varieties during 1949—51 is reported. Optimum results are obtained when the soil temp. is ⩽65°F. and day length ⩽14½ hr. E. G. BRICKELL.

Effect of planting date on chemical composition and growth characteristics of soya-beans. R. D. Osler and J. L. Cartter (*Agron. J.*, 1954, **46**, 267—270).—The effects of 3—4 planting dates on certain characteristics of seven varieties and one strain of soya-bean over three years were studied. Highest yields for early varieties were obtained by planting about May 15, and from late varieties about May 1. Maturation of late varieties was affected less by planting date than was that of early varieties. Lodging score generally increased with delay in planting. The % of oil in the seed and the I no. of the oil generally decreased, whilst protein % in the seed generally increased, with delay in planting. There were varietal differences with respect to most of the values measured. A. H. CORNFIELD.

Stimulation of yield in *Hevea brasiliensis* by the injection method. P. Campagnon and P. Tixier (*Arch. Rubbercult.*, 1953 [May], Extra No., 29—49).—Injection of $CuSO_4$ increased the yields of latex by 6—65%, and was beneficial to dried-up trees or those in which latex coagulated at the tapping cut. Cu probably acts by altering the permeability of the cells. HORT. ABSTR. (A. G. P.).

Stimulation of yield of rubber trees. Rubber Res. Inst. Malaya (*R.R.I.M. Plant Bull.*, 1953, No. 7, 89—92).—Application of 2 : 4-D in a palm oil base increased latex yields by 20—75%. Treatment with $CuSO_4$ is not recommended. HORT. ABSTR. (A. G. P.).

Stimulation of yield in *Hevea brasiliensis*. P. de Jonge (*Arch. Rubbercult.*, 1953 [May], Extra No., 7—26).—Application of Na salt of 2 : 4-D or 2 : 4 : 5-T in palm oil to the scraped bark of the trees below the tapping cut or injection of $CuSO_4$ considerably increased rubber yields mainly by extending the period of flow. HORT. ABSTR. (A. G. P.).

Stimulation of latex yields. L. K. Wiersum (*Arch. Rubbercult.*, 1953 [May], Extra No., 27—28).—Yields were increased by bark scraping (30%) and by treatment with palm oil (17%), coumarin (10%), a hormone 27%, $CuSO_4$ paste (30%), urea (15%), or lanoline (20%). None of the treatments caused appreciable change in the properties of the latex. HORT. ABSTR. (A. G. P.).

Physiological abnormalities of the tapping panel [in rubber trees]. P. Campagnon, P. Tixier, and G. Roujansky (*Arch. Rubbercult.*, 1953 [May], Extra No., 54—69).—The abnormalities described (coloration necrosis, partial drying deformation, coagulation of latex) were fewer in trees receiving NK, K, or NPK treatments. $CuSO_4$ reduced dryness but not browning of bast. The irregularities are probably due to deficiencies of K and Cu and are more prevalent in trees yielding dilute latex. HORT. ABSTR. (A. G. P.).

Germination of seed of *Cotoneaster zabeli*. B. C. Smith and L. C. Chadwick (*Proc. Amer. Soc. hort. Sci.*, 1953, **62**, 503—505).—For max. production of normal seedlings from excised embryos optimum stratification temp. for the seeds is 10·5°. Acid scarification of the seed coat reduced the necessary stratification time by one half. L. G. G. WARNE.

[Effect of] fertilisation during the growing and forcing periods on the growth and flowering of hydrangeas. J. B. Shanks and C. B. Link (*Proc. Amer. Soc. hort. Sci.*, 1953, **62**, 471—480).—A high N-level during the growing season is favourable to subsequent forcing. High N during forcing induces large dark green leaves, large influorescences, and a pink petal colour. L. G. G. WARNE.

Effects of various nutrient intensities on growth and development of snapdragons (*Antirrhinum majus*, L.). H. L. Flint and S. Asen (*Proc. Amer. Soc. hort. Sci.*, 1953, **62**, 481—486).—Snapdragons were grown in sand culture and supplied with nutrients in the molar ratios of KH_2PO_4 5, $Ca(NO_3)_2$ 17, $MgSO_4$ 13, K_2SO_4 13, $(NH_4)_2SO_4$ 12, $CaCl_2$ 5 (plus micronutrients) in solutions having osmotic pressures of 0·19, 0·38, 0·73, 1·46, and 2·78 atmospheres. Solutions with osmotic pressures above 0·73 atm. caused chlorosis, fading of flower colour, decreased flower and dry matter production, and shorter and weaker stems. The N, P, and K contents of the leaves increased with increasing concn. of the nutrient solution but the Mg and Ca contents did not show this relation to nutrient supply. L. G. G. WARNE.

Storage of herbicides. J. A. Kelley and L. L. Coulter (*Farm. Chem.*, 1954, **117**, No. 8, 42—46).—Factors affecting the storage properties of modern herbicide formulations are discussed and appropriate recommendations are made. Safe storage temp. for a no. of liquid prep. are listed. A. G. POLLARD.

Inactivation of herbicides containing growth-substances by absorption on charcoal. H. Orth (*Z. PflKrankh.*, 1954, **61**, 385—396).—2 : 4-D (Na salt, amine, or ester) is adsorbed by activated C. Seeds sprayed or dusted with C were protected from injury by 2 : 4-D previously applied to soil. Practical applications of these observations to methods of weed control are noted. A. G. POLLARD.

Soil effects on herbicides. Adsorption of 3-(p-chlorophenyl)-1 : 1-dimethylurea [CMU] as a function of soil constituents. H. R. Sherburne and V. H. Freed (*J. Agric. Food Chem.*, 1954, **2**, 937—939).—A method is described for determining the amount of CMU adsorbed by various types of soil and other adsorbents. CMU was adsorbed to a high degree by org. matter and to a significant extent by inorg. clay particles. Soil high in org. matter may therefore require higher dosages. More immediate results may be shown on sandy soils, but CMU may be lost more rapidly than on heavy soils. Best results should be obtained under fairly moist but not excessively wet conditions. S. C. JOLLY.

Effect of 2 : 4-D on translocation and accumulation of food materials in the bean plant. R. Garren, L. F. Remmert, and N. L. Lawrence (*Bot. Gaz.*, 1953, **115**, 105—121).—Application of 2 : 4-D to the distal pulvini of bean leaves retarded dry matter production by the plants mainly by restricting carbohydrate accumulation. Telemorphic and chemical effects of 2 : 4-D were apparent both above and below the point of application; they were more pronounced in younger plants and were influenced by environmental conditions. 2 : 4-D probably affects the succulence of plants. A. G. POLLARD.

Intake and movement of herbicides injected into mesquite. B. O. Blair and G. E. Glendening (*Bot. Gaz.*, 1953, **115**, 173—179).—One-minute injections of 2 : 4-D, 2 : 4 : 5-T, eosin, $NaClO_3$, and NH_4 sulphamate were made into stems of mesquite about 18 in. above ground level, entry of air being excluded. The amount of solution passing into the trees was largely influenced by the season (max. in Dec.); it was greater in the afternoon than in the morning and was inversely related to the R.H. The daily uptake was directly related to the difference between the morning and afternoon humidities. In general the uptake of org. chemicals was > that of inorg. substances. Within the trees Na_3AsO_3 was translocated freely and after injection for 2 hr. killed the entire tops of trees. 2 : 4-D was translocated only to the stem directly above the point of injection. Based on experimental data recommendations are made for the destruction of mesquite by injection. A. G. POLLARD.

The future of chemicals in cotton weed control. W. B. Ennis, jun. (*Farm. Chem.*, 1954, **117**, 55—58).—A lecture. A. G. POLLARD.

Range brush control. A. H. Walker (*Farm. Chem.*, 1954, **117**, No. 3, 49—50).—Results of destruction of brush (sagebush, mesquite, blackjack oak, etc.) by 2 : 4-D and 2 : 4 : 5-T for increasing grazing areas are reported. A. G. POLLARD.

Effect of sodium dichlorophenoxyacetate on crop and weeds in wheat. H. K. Pande (*Agra Univ. J. Res.*, 1954, **3**, 241—252).—Effects of applications of (Na) 2 : 4-D at 3·25, 4·88, and 6·50 lb. per acre at three (tiller, boot, and bloom) stages of wheat growth are described. At the early stage even the lowest concn. gave 80% kill of all weeds except *Cyperus rotundus*; higher concn. were more effective particularly at the early stage. The treatment did not affect the vegetative growth of the crop but increased the yield and N content of the grain. E. G. BRICKELL.

Companion crops for weed control in soya-beans. R. G. Robinson and R. S. Dunham (*Agron. J.*, 1954, **46**, 278—281).—Soya-beans sown with winter wheat or winter rye as companion crops yielded as much or more than did those without companion crops whether in non-cultivated rows 6 in. apart or in cultivated rows 40 in. apart. Weed control with companion crops was much superior to that with no companion crop in non-cultivated soya-beans, and was about equal to that achieved by cultivation. Winter vetch, lucerne, medium red clover, bromegrass, and timothy companion crops did not give satisfactory weed control. Field peas as a companion crop resulted in lodging of the soya-beans. Sowing the soya-beans and companion crop at the same time was more satisfactory than establishing the companion crop prior to sowing soya-beans. A. H. CORNFIELD.

Effect of herbicides on the drying rate of hay crops. W. K. Kennedy, W. H. Hesse, and C. M. Johnson (*Agron. J.*, 1954, **46**, 199—203).—Of the herbicides tested dinitro-*o*-*sec*.-butylphenol (1·1 lb.) and Na_2 3 : 6-*endo*-oxyhexahydrophthalate (Endothal) had the best forage-drying properties. Best results were obtained when the herbicides were applied 24—48 hr. prior to cutting. The quality of the treated hay was not as good as that of untreated hay and the differences in drying time between treated and untreated hay were too small to make the treatment either economical or practical. A. H. CORNFIELD.

Control of downy bromegrass in an established lucerne field. M. G. Wiltse and B. R. Churchill (*Agron. J.*, 1954, **46**, 160—162).—The application of TCA (4·5—9·0 lb.) or IPC (2·5—10·0 lb.) per acre in the autumn gave very good control of downy bromegrass in an established lucerne field, and increased the yields of lucerne. Spring applications did not give such satisfactory control. The application of 18 lb. of TCA in autumn or spring or 10 lb. of IPC in spring injured the lucerne somewhat. A. H. CORNFIELD.

Interrelations of methods of weed control and pasture management. D. L. Klingman (*Dissert. Abstr.*, 1954, **14**, 1124).—Mowing pasture plots in June for three years reduced stands of perennial weeds by ~35%; 1 lb. of 2 : 4-D ester, per acre on the same dates reduced stands by 70%; ploughing and reseeding (+ 2 : 4-D) reduced perennial weed stands by 89—94%. With the reduction of weeds, there was a large increase in basal density of desirable grasses. Weed control treatments increased the amount of forage eaten. E. M. J.

Effect of chemical structure on biological activity. Significance of chlorine in certain insecticides, fungicides, and plant growth regulators. D. Woodcock (*A.R. agric. hort. Res. Sta. Bristol*, 1953, 96—101).—A review. A. H. CORNFIELD.

Configuration and action of certain insecticides. Stereochemical examination and toxicology of DDT analogues. R. Riemschneider (*Chim. et Industr.*, 1954, **72**, 261—270).—The insecticidal activity of DDT analogues is discussed with special reference to the "possibility of free rotation" of the aromatic rings and the CCl, $CHCl_2$, and CCl:CCl_2 groups. By use of molecular models, it is deduced that there is a parallelism between the "degree of free rotation" and the efficacy of the substances in contact insecticides. H. S. R.

Developments in agricultural chemicals. Anon. (*J. Agric. Food Chem.*, 1954, **2**, 916—928).—A survey is presented of the economic status and technical progress in America and other parts of the world during the 1953—4 season, as regards insecticides, herbicides, etc. S. C. JOLLY.

Formulation [of toxicants] as related to field performance. N. F. Hardnan and H. O. Thomas, jun. (*J. Agric. Food Chem.*, 1954, **2**, 929—932).—The importance of correct formulation of possible toxicants for laboratory and field tests is emphasised and discussed. S. C. JOLLY.

Mode of action of modern synthetic insecticides. F. Duspiva (*Angew. Che.m*, 1954, **66**, 541—551).—A review of the work during the last ten years on the subject, with special reference to organic phosphorus derivatives (thiophosphates, etc.). In many cases the true insecticide is produced from the starting material through enzymic conversion to anticholine-esterase. The possibility of the occurrence of the acetylcholine-choline-esterase system in the insect body is discussed, in addition to the inactivation of some insecticides within the organism. (134 references.) R. C. MURRAY.

Mode of action of insecticides. II. Inhibition of the acetylesterases of the locust nerve cord by some organic phosphoric esters. H. S. Hopf (*Ann. appl. Biol.*, 1954, **41**, 248—260).—Tetraethylpyrophosphate inhibited the hydrolysing action of homogenate of the thoracic nervous system of locusts on acetylcholine and *o*-nitrophenylacetate. There was good correlation between the *in vitro* activity of four chlorinated diethylphenyl phosphates against the nerve-cord acetylesterases and their contact activity against aphids. There was poor correlation between the former and injection toxicity to locusts or between inhibition of horse-serum choline-esterase and injection toxicity to mice. A. H. CORNFIELD.

Biological techniques for the evaluation of fungicides. III. Evaluation of soil fungicides for the control of club-root disease of Brassicæ. J. Colhoun (*Ann. appl. Biol.*, 1954, **41**, 290—304).—Details of the technique are described. A. H. CORNFIELD.

Improvement in fungicides through formulations. C. C. Yeager (*Canad. chem. Process.*, 1954, **38**, No. 7, 58—59).—A short review is given of the modern trends in commercial fungicide formulation and includes the use of Cu 8-quinolinolate, dihydroxydichlorodiphenylmethane, and dehydrogenated rosin amine pentachlorophenate. (13 references.) G. R. WHALLEY.

Use of ^{32}P in tracing some insect–plant relations of the thistle. R. C. Pendleton and A. W. Grindman (*Ecology*, 1954, **35**, 187—191).—The plant was fed with radioactive P and the fate of this subsequently examined. It was thus possible to trace the P from plant to aphis, to honeydew and to ant, and the predatory activities of insects which feed on aphids could be estimated. L. G. G. WARNE.

Biological screening test for chlorinated insecticides. Bernard Davidow and F. J. Sabatino (*J. Ass. off. agric. Chem., Wash.*, 1954, **37**, 902—905).—The sensitivity of goldfish to DDT, Lindane, Heptachlor, Toxaphene, Dieldrin, Aldrin, Chlordane, Methoxychlor, and Dilan has been determined approximately by observation of the onset of convulsions and loss of equilibrium. *Daphnia magna* may also prove to be a suitable test organism. For the examination of foods, a puree is distilled with steam and goldfish placed in the distillate are observed for 3 hr. A. A. ELDRIDGE.

Laboratory evaluation of certain nematicidal materials. W. A. Feder (*Phytopathology*, 1954, **44**, 428—430).—Small pieces of nematode-infested material are placed on a watch glass on a filter paper under a petri dish. The paper is wetted with 1 ml. of an aq. solution of the toxicant under test. After 48 hr. the tissue is teased apart under water, soaked for 3 hr. and the no. of living, dead, and injured nematodes counted. For use in constant temp. baths the tissue is supported on a cotton plug in a test tube, the toxicant being placed in the bottom of the tube. The tube is then corked and placed in the bath. Org. P insecticides were examined by this method and dosage response curves were plotted; from such curves the LD_{50} of Parathion, Shell 1836 (diethyl 1-chlorovinyl phosphate), Demeton (diethoxy-thiophosphoric acid ester of 2-ethylmercaptoethanol), EPN (ethyl *p*-nitrophenyl benzenethiophosphonate), and Malathion were found to be 1·0, 1·5, 3·0, 4·5, and 5·0 p.p.m. respectively for *Aphelenchoides besseyi* and *Ditylenchus dipsaci*. T. G. MORRIS.

Glyodin : a coined name for the fungicidal chemical, 2-heptadecylglyoxalidine acetate. Interdept. Comm. on Pest Control (*Phytopathology*, 1954, **44**, 370).—Official recognition of the term "Glyodin" for the pure chemical is reported. A. G. POLLARD.

Dichlone : a coined name for the fungicidal chemical, 2 : 3-dichloro-1 : 4-naphthoquinone. Interdept. Comm. on Pest Control (*Phytopathology*, 1954, **44**, 370).—"Dichlone" is now the officially accepted (U.S.A.) designation of the pure chemical. A. G. POLLARD.

Therapy of nematode infections of plants with 3-*p*-chlorophenyl-5-methylrhodanine. A. C. Tarjan (*Phytopathology*, 1954, **44**, 431—432).—Aq. emulsions of 3-*p*-chlorophenyl-5-methylrhodanine applied at the rate of 2 g. per sq. ft. to potted tomatoes completely controlled *Meloidogyne incognita*. At a rate of 1 g. per sq. ft. the no. of female nematodes was reduced to <50% of that on controls. The dry material was quite ineffective when applied at a rate of 4 g. per sq. ft. to the upper inch of soil around infected plants. Aq. foliar sprays containing 10,000 p.p.m. were also ineffective. Non-infected plants could not be infected by inoculation with egg masses when planted in soil in which the dry powder had been mixed at a rate of ≮0·5 g. per sq. ft. T. G. MORRIS.

Systemic insecticidal action of certain compounds of fluorine and of phosphorus on *Phaedon cochleariæ*, Fab. (mustard beetle). W. A. L. David and B. O. C. Gardiner (*Ann. appl. Biol.*, 1954, **41**, 261—270).—As contact and stomach poisons against mustard beetle adults and larvae toxicity decreased in the order diethyl *p*-nitrophenyl phosphate (Paraoxon), CF_3·COONa (**I**) ≏ bis(dimethylamino)fluorphosphine oxide (Dimefox), bisdimethylaminophosphonous anhydride (Schradan). When applied systemically at practical concn. both Paraoxon and Dimefox gave complete kill of the adult beetle, whilst Schradan and **I** were ineffective. A. H. CORNFIELD.

Fungicidal properties of coal tar distillates. G. V. Coles and R. J. W. Byrde (*A.R. agric. hort. Res. Sta. Bristol*, 1953, 109—120).—Commercial coal tar fungicides used in Malaya for the control of *Ceratostomella fimbriata* (which causes mouldy rot of rubber trees) varied in efficiency of control. The high-boiling tar acid fractions gave the max. fungicidal activity in bioassay tests. The fungicidal activities of the acidic and neutral tar fractions were influenced by their boiling range and the method used for preparing the coal tar. Laboratory bioassays reflected the field performance of the materials. A. H. CORNFIELD.

Vapour action of certain mercury seed treatment materials. D. C. Arny and C. Leben (*Phytopathology*, 1954, **44**, 380—383).—With four mercurial seed-dressings examined, viz., Ceresan M (7·7% mercuriethyltoluene-*p*-sulphonanilide), Panogen (2·2% mercurimethyldicyanodiamide), Agrox (6·7% mercuriphenyl urea) and Setrete (7·0% NH_4 mercuriphenylacetate) a general parallelism existed between relative ability to control Victoria blight (*Helminthosporium victoriæ*) when applied directly to the seed and that in the vapour form. The first-named two substances completely controlled the blight in oats by vapour action alone. A. G. POLLARD.

Antibiotic soil organisms. II. Bacteria and fungi antagonistic to *Pythium arrhenomanes* in sugar cane soils of Louisiana. H. H. Luke and T. D. Connell (*Phytopathology*, 1954, **44**, 377—379).—Antibiotic activity was determined by the plate culture method. In general fungi were more active than bacteria in this respect. pH was an important factor. Bacterial populations were greatest in soils having pH >7·6. The antibiotic action of fungi was max. at pH 6·9 and tended to be high in soils in which root-rot was most severe. Bacterial antibiotic effects were generally max. in spring and greater in soils less seriously affected by root-rot. A. G. POLLARD.

Antagonism between *Blastomyces luteus* and species of *Verticillium*. I. Isaac (*Ann. appl. Biol.*, 1954, **41**, 305—310).—In culture studies the presence of *Blastomyces luteus* mycelium inhibited the growth of *Verticillium albo-atrum* and *V. dahliæ* at pH 3·0—9·6 at 10—30°. Filtered media (boiled or unboiled) in which *B. luteus* had developed inhibited the growth of both species of *Verticillium*. No control of the disease in tomato and antirrhinum was obtained by injecting into them a filtered media in which *B. luteus* had developed. Marked reduction in incidence of the disease occurred when *B. luteus* was added to *Verticillium*-infected soil at least three months prior to planting. A. H. CORNFIELD.

Toxins produced *in vitro* by *Verticillium albo-atrum*. R. J. Green, jun. (*Phytopathology*, 1954, **44**, 433—437).—The initial response of tomato cuttings when placed in various dilutions of a 30-day culture filtrate of *V. albo-atrum*, was wilting, especially in 1 : 2 and 1 : 3 dilutions. Recovery was partial or complete in 24 to 72 hr. during which time there was a progressive intercostal blanching of the leaflets. Chlorosis and desiccation followed, especially in the lower leaves. With a filtrate dilution of 1 : 5 wilting was slight. The toxic principle in the filtrate was removed by ethanol but was altered in the process. After treatment of the filtrate with $Zn(OH)_2$ it did not induce wilt, but gave rise to a discoloration and blocking of the vessels of the stem. The toxic fraction responsible for chlorosis was thermolabile and easily hydrolysed by acid. Accumulation of nitrites occurring temporarily in the culture medium was not responsible for the wilting. The discoloration of the stem was due to polysaccharide. T. G. MORRIS.

Production and properties of antimycin A from a new *Streptomyces* isolate. J. L. Lockwood, C. Leben and G. W. Keitt (*Phytopathology*, 1954, **44**, 438—446).—The prep. and properties of antimycin A 102 from cultures of *Streptomyces* sp. 102, are described. Growth of nearly all of 16 plant pathogenic fungi, and five yeasts was restricted by EtOH but was altered in the process. After treatment of μg./ml. inhibition did not occur. The growth of 10 bacteria (five plant pathogens) was restricted at the highest concn. by the partly purified but not by the cryst. prep., but the range of partial inhibition was narrower than with fungi. The degree of inhibition of most fungi tended to increase with fall in pH. Partly purified antimycin A 102 in aq. suspensions, used as spray against early blight, showed average ED_{50} and ED_{95} val. of 23 and 297 μg./ml. respectively. After four days, 70% of the original activity remained. No phytotoxicity to a variety of plants was found with sprays of 2·9 mg./ml. of A 102. Partly purified antimycin was effective in controlling seedling blight of oats (*Helminthosporium*), but was only partially effective for the same blight in barley. A 102 and a previously reported cryst. antibiotic A 35 isolated from cultures of *Streptomyces* sp. 35 are compared. T. G. MORRIS.

Response of nut grass to soil applications of organic insecticides. J. G. Watts (*J. econ. Ent.*, 1954, **47**, 435—438).—A significant increase in the abundance of nut grass, *Cyperus rotundus*, was apparently associated with accumulations in the soil of Chlordane, DDT, Toxaphene, and especially $C_6H_6Cl_6$, but not Parathion. Neither insect nor nematode control appear to be involved. The possibility of insecticides interfering with the auxins which control the apical dominances in the rhizome system is discussed. A. A. MARSDEN.

Seed dressing for protection of oleaginous *Cruciferæ* against *Phyllotreta* species and *Psylloides chrysocephala*. L. Bonnemaison and E. Roubaud (*C. R. Acad. Agric. Fr.*, 1954, **40**, 491—493).—Satisfactory protection of the seedlings, without reduction in germinating power of the seeds is generally obtained by dry dressing with Lindane, using 10—12 g. of Lindane (containing 65% of γ-$C_6H_6Cl_6$) per kg. of seed. Heavy infestations or rainfall may necessitate a spraying of the seedlings with Lindane. P. S. ARUP.

DDT-accumulation in soils in relation to different crops. J. M. Ginsburg and J. P. Reed (*J. econ. Ent.*, 1954, **47**, 467—474).—After six years of commercial spray and dust treatments, samples of soils from apple orchards, maize and potato fields, and a cranberry bog were analysed for DDT. In the apple orchards and cranberry bog most of the DDT was present in the top 4 in. of soil. Almost all the DDT present in maize and potato soils occurred in the top 9 in. of soil. DDT residues did not penetrate vertically downwards below plough and cultivation depths. Variation in soil type did not alter the amount of DDT retained from residues. A. A. MARSDEN.

Determination of DDT in plant materials. J. T. Martin and R. F. Batt (*A.R. agric. hort. Res. Sta. Bristol*, 1953, 121—128).—The plant material is extracted with CCl_4. Waxes and pigments are removed from the extract with Al_2O_3. After nitration and neutralisation, the nitrated DDT is extracted with CCl_4. On treatment with alcoholic KOH, a blue colour, the depth of which is proportional to the amount of DDT present, is produced. A. H. CORNFIELD.

Hybridisation among mosquitoes and its possible relation to the problem of insecticide resistance. L. E. Rozeboom (*J. econ. Ent.*, 1954, **47**, 383—387).—Changes in habits, plus inheritance of resistance may lead to the formation of mosquito populations which will be very difficult to control. A. A. MARSDEN.

Genetics of resistance to DDT in *Drosophila melanogaster*. J. C. King (*J. econ. Ent.*, 1954, **47**, 387—393).—Lines of *D. melanogaster* resistant to DDT were carried from two different stocks through 20 generations. One stock showed no response and the other stock developed increased resistance which was greatest at the LD_{50} level of selective intensity. Two crosses between different lines gave F_1 intermediate in resistance and F_2 of lower resistance and greater variance than the F_1. All data obtained suggest the existence of a complex polygenic system of genetic factors. A. A. MARSDEN.

Analysis of a DDT-resistant strain of *Drosophila*. J. F. Crow (*J. econ. Ent.*, 1954, **47**, 393—398).—A resistant strain of *Drosophila* when exposed to DDT for 18—24 hr. at relatively low concn. showed an LD_{50} approx. 2000 times that of a susceptible strain. With higher concn. of DDT the LD_{50} were only about six times as great. Analysis of the development of resistance and of the F_1 and F_2 hybrids suggests polygenic inheritance. No reversion to susceptibility occurred in a resistant strain after three years without further exposure to DDT. A. A. MARSDEN.

Hessian fly in relation to the development of crown and basal stem rot of wheat. M. G. Boosalis (*Phytopathology*, 1954, **44**, 224—229).—Infection of wheat by the organisms of the two rots (mainly *Helminthosporium* and *Fusarium* spp.) frequently followed damage by the Hessian fly larvæ. A. G. POLLARD.

Influence of temperature on development of powdery mildew on spring wheats. M. C. Futrell and J. G. Dickson (*Phytopathology*, 1954, **44**, 247—251).—Data for 15 varieties of wheat and temp. ranges of 16—28° are recorded. A. G. POLLARD.

Inheritance of resistance to stem rust and powdery mildew in cytologically stable spring wheats derived from *Triticum timopheevi*. R. W. Allard and R. G. Shands (*Phytopathology*, 1954, **44**, 266—274).—A study in plant breeding. A. G. POLLARD.

Effect of infection by *Helminthosporium sativum* on amino-acid content of wheat roots. S. B. Hrushovetz (*Canad. J. Bot.*, 1954, **32,** 571—575).—The total N (dry basis) was greater in diseased than in healthy roots. The aggregate content of both free and combined amino-acids was slightly higher in diseased than in healthy roots. The concn. of free alanine, serine, and asparagine, in diseased roots were twice those in healthy ones. R. H. HURST.

Variations in virulence of *Tilletia tritici*, depending on passaging through different strains of wheat. V. P. Murav'ev (*Dokl. Akad. Nauk SSSR*, 1954, **96,** 857—859).—The virulence of *Tilletia* spores taken from resistant strains of wheat exceeds that from susceptible strains. R. TRUSCOE.

Relationship of temperature and stage of growth to the crown rust reaction of certain varieties of oats. M. D. Simons (*Phytopathology*, 1954, **44,** 221—223).—Of eleven varieties of oats examined nearly all were more resistant to crown rust at 15° than at 25° and more resistant in the later than in the earlier stages of growth. Telial development tended to be greater at 25° than at 15° : it was largely unaffected by the stage of growth of the host at 15° but at 25° was more abundant in the early growth stages. A. G. POLLARD.

Effects of accelerated electrons or cathode rays on certain insects and on the wheat and flour they infest. II. V. H. Baker, O. Taboada, and D. E. Wiant (*Mich. agric. Exp. Sta. Quart. Bull.*, 1954, **36,** 448—461).—Irradiation experiments, using the Van de Graaf electron accelerator, for the control of weevils in flour, wheat, and beans are recorded and data on dosage, penetration, costs, etc. are presented. Methods described offer promise of effective insect control by preventing reproduction and sterilising insect eggs. A. G. POLLARD.

Spotted maize beetle. B. L. Louw (*Fmg S. Afr.*, 1954, **29,** 281—285).—The life history and habits of *Astylus atromaculatus* are described. Dieldrin gives control. DDT was ineffective. E. G. BRICKELL.

Chemical control of *Euxoa segetum*, Schiff, a pest injurious to maize in S.W. France. P. Anglade (*C. R. Acad. Agric. Fr.*, 1954, **40,** 535—528).—Sporadic infestations are satisfactorily counteracted by spraying, as early as possible, the plants and the neighbouring soil with emulsions based on DDT, DDT + Lindane (5 : 1), Chlordane, or Aldrin. P. S. ARUP.

New experiences with Folidol-E 605 in the control of rice stem-borer. P. Israel and G. Vedamoorthy (*Curr. Sci.*, 1954, **23,** 211—212).—Virtually complete control of stem-borer (*Chilo simplex*, B.) incidence is obtained by soaking the seeds in 0·1% Folidol (an organo-phosphorus compound) solution and subsequently irrigating with solution of the same concn. L. F. TAYLOR.

Sap-transmissable mosaic diseases of solanaceous crops in Trinidad. W. T. Dale (*Ann. appl. Biol.*, 1954, **41,** 240—247).—Host reactions, properties, and transmission characteristics of the pepper vein-banding virus and egg-plant mosaic virus are reported. A. H. CORNFIELD.

Methods for the detection of resting sporangia of potato wart [*Synchytrium endobioticum*, (Schilb.), Perc.] in infested soil. H. Mygind (*Acta agric. scand.*, 1954, **3,** 317—343).—Flotation and sedimentation experiments are described. A mixture of equal parts of paraffin and light petroleum gave the greatest number of floated sporangia per drop of floated material using the method of Cleve and Buchwald (*Die Müllerei*, 1950, Nr., 13). E. G. BRICKELL.

Comparison of dilute and concentrated sprays for control of insects of potato and tomato. D. O. Wolfenbarger (*J. econ. Ent.*, 1954, **47,** 537—539).—Concentrated and dil. Parathion sprays were equally effective in reduction of aphids and serpentine leaf miners, *Liriomyza pusilla*, on potatoes, and *L. pusilla*, *Heliothis armigera*, and *Laphysma frugiperda* on tomato plants. Concentrate sprays applied by a mist-blower or by nozzles gave practically equal insect control. A. A. MARSDEN.

Investigation of *Rhizoctonia crocorum*, (Pers.), DC., in relation to the violet root rot of carrot. N. J. Whitney (*Canad. J. Bot.*, 1954, **32,** 679—704).—Isolation of the fungus from diseased carrot was successful only from mature infection bodies. Three types of hyphæ were produced, but only those of the subiculum propagated the fungus, and only the subiculum and sclerotia could initiate a parasite attack on carrots. The development of the carrot, the growth of *R. crocorum*, and the incidence of infection, were max. at pH 5·5—6·5. The temp. for best growth of the fungus and the host was clearly correlated with that for max. infection. Infection occurred when the plants were eight weeks old, and the disease spread until the carrots matured. R. H. HURST.

Investigations on the control of root rot of canning peas. H. G. Johnson (*Dissert. Abstr.*, 1954, **14,** 1124).—*Aphanomyces euteiches*, Drechs., is the most important cause of root rot of canning peas in Minnesota, heavy infestations being found in fields in which peas were grown intensively. Greenhouse tests were made on field soil samples to find the degree of root rot to be expected in the next season. Methods used against the fungus were tile drainage, the use of commercial N fertiliser, well rotted org. matter, and green rye manure. Crops of oats, soya-beans, maize, lucerne, or red clover preceding peas, had no effect on the degree of soil infestation but a previous pea crop always increased the soil infestation. A fungicidal soil fumigant, OS-1199, gave good control of root rot. E. M. J.

Factors influencing development of bacterial blight of peas. D. C. Wark (*Aust. J. agric. Res.*, 1954, **5,** 365—371).—Development of the disease (due to *Pseudomonas pisi*, Sackett) is favoured by exposing the plants to low temp., and by growing on soil of high moisture content ; soil-type also has some influence. R. H. HURST.

Insects affecting lucerne. E. C. Martin (*Mich. agric. Exp. Sta. Quart. Bull.*, 1954, **36,** 469—476).—Results of trials with various insecticides in the control of *Lygus* spp. *Adelphocoris* spp., aphids, spittle-bugs, and leafhoppers are recorded. Malathion + methoxychlor was the most effective against spittle bugs and leafhoppers and BHC against *Lygus* and *Adelphocoris*. A. G. POLLARD.

Repellency of Toxaphene dust and Parathion spray to *Nomia melanderi* in blossoming lucerne. H. F. Merke (*J. econ. Ent.*, 1954, **47,** 539—540).—A Toxaphene (15%) dust, 30 lb. per acre, on blossoming lucerne had little effect on, or repellency to alkali bee (*Nomia melanderi*) activity. Parathion (10 oz. per acre) showed little repellency to these bees and ~30% of bees nesting nearby were poisoned by this insecticide. A. A. MARSDEN.

Root and crown rots of red clover in Wisconsin and the relative presence of associated fungi. R. A. Kilpatrick, E. W. Hanson, and J. G. Dickson (*Phytopathology*, 1954, **44,** 252—259).—The incidence of the rots and the nature of the damage they cause are examined. Fungi most commonly found on diseased roots were *Fusarium oxysporium*, *F. solani*, *F. roseum*, *Phoma* spp., *Rhizoctonia* spp., and *Gliocladium roseum*. Factors affecting the prevalence of the individual fungal species are noted. A. G. POLLARD.

Controlling the green June beetle grub in clover-grass pasture. J. R. Dogger (*Farm. Chem.*, 1954, **117,** No. 7, 32—33).—A brief review of control methods in Carolina. Parathion, preferably in a dust or granular form is effective and its residual action is suitably brief. A. G. POLLARD.

Four years of research on the enemies of cider apple trees in Normandy. B. Trouvelot, J. Arnoux, and D. Martouret (*C. R. Acad. Agric. Fr.*, 1954, **40,** 471—474).—The pests which attack cider apple trees and the conditions which favour their development are discussed. A knowledge of secondary hosts is important. To control the fluctuations of populations of cider apple tree pests it is necessary to estimate the degree of infestation and to use preventive treatment which includes that against natural auxiliary fauna. In this way the eradication is a matter of time only, before the regularly good harvest crop is obtained. E. M. J.

Infection of apple stems through wounds caused by geese. E. W. Hobbis and R. W. Marsh (*A.R. agric. hort. Res. Sta. Bristol*, 1953, 89—90).—Cankering, due to *Glœosporium*, of apple stems was traced to wounds caused by geese. The extent of damage was not related to variety. Stems greater than 0·5 in. diameter were not damaged. A. H. CORNFIELD.

Fungal rots of apples with special reference to *Glœosporium* spp. E. H. Wilkinson (*Ann. appl. Biol.*, 1954, **41,** 354—358).—*Glœosporium* were the most important organisms causing rot of apples during storage. Factors affecting the apparent increase of lentical rotting are discussed. A. H. CORNFIELD.

Eradicant fungicides for the control of apple canker. II. R. J. W. Byrde and A. T. K. Corke (*A.R. agric. hort. Res. Sta. Bristol*, 1953, 159—162).—The application of HgPh chloride (0·3% suspension in 0·3% sulphite lye) in late autumn suppressed the sporulation of *Nectria galligena*, Bres. for a considerable period and reduced leaf scar infection. Na pentachlorophenate and pentachlorophenol were less effective. Subsequent growth of established cankers was not arrested by the treatments. A. H. CORNFIELD.

Sporulation of *Sclerotinia fructigena* on mummified apples and pears in late spring and summer. R. J. W. Byrde (*A.R. agric. hort. Res. Sta. Bristol*, 1953, 163—166).—Outbreaks of sporulation of *S. fructigena* on overwintered mummified apples and plums were associated with moderate rainfall during the previous 24 hr. coupled with relatively high overnight temp. A. H. CORNFIELD.

Importance of timing for successful apple scab sprays. D. Cation (*Mich. agric. Exp. Sta., Quart. Bull.* 1954, **36,** 349—356).—Results

of spraying programmes in two Michigan orchards during 1953 are reported. A. G. POLLARD.

Control of apple scab by small-volume sprays. H. G. H. Kearns, R. W. Marsh, and N. G. Morgan (*A.R. agric. hort. Res. Sta.*, 1953, 149—153).—Air-flow small-vol. (100—150 gal. per acre) spraying with lime–sulphur (0·75—1·00%) 4—5 times during the season gave poor control of apple scab whilst large-volume (>500 gal. per acre) lance spraying under similar conditions gave very good control. A. H. CORNFIELD.

Apple scab resistance from a number of *Malus* species. J. R. Shay, D. F. Dayton, and L. F. Hough (*Proc. Amer. Soc. hort. Sci.*, 1953, **62**, 348—356).—A number of clones resistant to apple scab (*Venturia inequalis*) derived from *M. prunifolia*, *M. zumi calocarpa*, *M. atrosanguinea*, *M. micromalus*, and *M. baccata* possess other unusual characters, *e.g.*, desirable skin types and flesh characters, and attractive fruit colour and some of these desirable features are exhibited together with scab resistance by offspring of crosses between these clones and commercial apple varieties. L. G. G. WARNE.

Apple scab resistance from *Malus floribunda*, Sieb. L. F. Hough, J. R. Shay, and D. F. Dayton (*Proc. Amer. Soc. hort. Sci.*, 1953, **62**, 341—347).—In *M. floribunda*, resistance to scab (*Venturia inequalis*) is due to a dominant gene not linked with genes causing small fruit size or other undesirable characters and many of the seedlings obtained by crossing it with commercial varieties are of distinct promise. L. G. G. WARNE.

Apple scab resistance from R 12740-7A, a Russian apple. D. F. Dayton, J. R. Shay, and L. F. Hough (*Proc. Amer. Soc. hort. Sci.*, 1953, **62**, 334—340).—This Russian apple (*Malus pumila*) is highly resistant to apple scab (*Venturia inequalis*) and confers this resistance on a high proportion of the progeny obtained by crossing it with commercial apple varieties. L. G. G. WARNE.

Spraying experiments against apple and pear scab at Long Ashton, 1953. R. J. W. Byrde, A. H. Fielding, and C. W. Harper (*A.R. agric. hort. Res. Sta. Bristol*, 1953, 167—170).—Better control of scab and higher yields of apples were obtained where Captan (*N*-trichloromethylthio-tetrahydrophthalimide) (0·1%) was applied than where standard lime–sulphur sprays were given. Captan had little effect on apple mildew. Both Captan and 2-heptadecyl-glyoxalidine (0·125%) were satisfactory as post-blossom scab sprays on S-sensitive varieties of apple and pear. A. H. CORNFIELD.

Effects of spraying techniques on the control of some fruit insects. H. G. H. Kearns and N. G. Morgan (*A.R. agric. hort. Res. Sta. Bristol*, 1953, 139—145).—Air-flow mist spraying gave very good control of the leaf-curling plum aphid (DDT emulsion) and apple aphides (DDT–γ-$C_6H_6Cl_6$) and used only 25—33% of the amount of water and insecticides used by hand-lance " run-off " methods. Commercial control of apple sawfly was obtained by air-flow mist application of γ-$C_6H_6Cl_6$ (0·014%; 1 gal. per tree). A. H. CORNFIELD.

[Control of] the periodical cicada in southern Pennsylvania in 1953. D. Asquith (*J. econ. Ent.*, 1954, **47**, 457—459).—Cicadas in apple orchards were controlled by spraying with 40% TEPP (6 oz. and 1 pint per 100 gal. in dil. and conc. spray, respectively). The no. of applications necessary depended on reinfestation from nearby woodland. Addition of TM 341 (34% 2-heptadecylglyoxalidine acetate in Pr^{i}OH), lime–DDT, phenothiazine, Pb arsenate soya-bean flour, or Captan–DDT reduced the effectiveness of TEPP. Addition of Ferbam–DDT to the standard TEPP (1 pint per 100 gal.) spray gave no reduction in control unless the dosage was reduced to 75 gal. per acre. A. A. MARSDEN.

Insecticides for apple maggot control. R. W. Dean (*J. econ. Ent.*, 1954, **47**, 479—485).—In the laboratory, residual effectiveness against apple maggot flies was: Dieldrin > Heptachlor > DDT > Parathion. Compound 1189 (2 : 3 : 3a : 4 : 5 : 6 : 7 : 7a : 8 : 8-decachloro-3a : 3 : 4 : 7 : 7a-tetrahydro-4 : 7-methanoinden-1-one), Strobane, and Diasinon were highly toxic to the flies, but Aramite was less effective. In the orchard, Q-137 (Perthane) wettable powder used at 1 lb. of toxicant per 100 gal. and applied 4—6 times during the season kept infestations of *Rhagoletis pomonella* to a low level. As an emulsion or dust Q-137 was less effective. CS-708 (Dilan) (4 lb. of 25% wettable powder per 100 gal.) also gave good control, but Methoxychlor, DDT–Parathion, Malathion, Compound 1189, and Dieldrin were either ineffective or gave erratic results. A. A. MARSDEN.

The choline-esterase systems of three species of fruit flies and the effects of certain insecticidal compounds on these enzymes. C. C. Roan and S. Maeda (*J. econ. Ent.*, 1954, **47**, 507—514).—The rates of hydrolysis of various concn. of the substrates acetylcholine ACh) and acetyl-β-methylcholine (AMeCh) by the choline-esterase (ChE) of the oriental fruit fly, *Dacus dorsalis*, the melon fly, *Dacus cucurbitæ*, and the Mediterranean fruit fly, *Ceratitis capitata*, were determined. Theoretical max. velocities (V_{max}) and dissociation constants (K_s) for the reaction between the substrates and the ChE of these insects were caloulated. The concn. of 22 insecticides (org. P compounds and alkyl carbamic esters) required to inhibit 50% of the ChE of these insects *in vitro* were determined. The enzyme in all three species was specific for acetylcholine. Hydrolysis curves for the substrates showed similar max., and data for V_{max} and K_s were of the same order for all three species. Other factors than the enzyme may be important in the *in vivo* reactions of these compounds. A. A. MARSDEN.

Miticidal action of barium and manganese ethylene bisdithiocarbamates. S. Rich (*Phytopathology*, 1954, **44**, 387).—Both the Ba and Mn salts controlled *Paratetranychus pilosus* on orchard trees and *Tetranychus bimaculatus* on beans. The related prep. Nabam and Zineb were ineffective. The Ba salt afforded good protection against apple scab when used as a foliage spray. A. G. POLLARD.

Effect of time of application and influence of site of deposition of benzene hexachloride on the control of the apple sawfly (*Hoplocampa testudinea*, Klug). S. H. Bennett (*A.R. agric. hort. Res. Sta. Bristol*, 1953, 135—138).—When γ-$C_6H_6Cl_6$ (0·014%) was applied before egg hatch, appreciable control of sawfly larvæ was obtained without complete coverage of the fruitlet. When application was delayed until after commencement of egg hatch, only flooding of the calyx cup or complete wetting of the truss gave efficient control. Application at late pink bud blossom stage gave promising control of adult sawflies. A. H. CORNFIELD.

DDT–benzene hexachloride emulsion of high wetting properties as a substitute for winter washes. H. G. H. Kearns and N. G. Morgan (*A.R. agric. hort. Res. Sta. Bristol*, 1953, 146—148).—The method of preparing the emulsion is described. The value of the wash as a substitute for winter washes on apples, pears, and currants is discussed. A. H. CORNFIELD.

Control of apple and plum aphides by DDT and benzene hexachloride spring washes. S. H. Bennett (*A. R. agric. hort. Res. Sta. Bristol*, 129—134).—Satisfactory control of apple aphides was obtained with γ-$C_6H_6Cl_6$ (0·013—0·014%) applied as an emulsion at early bud burst and at early to mid-green cluster stages, and as wettable powder at the late pink bud blossom stage. DDT (0·025%) and $C_6H_6Cl_6$ (0·007%) were both effective at the early green cluster stage. When applied in Jan., Feb., or March, $C_6H_6Cl_6$ (0·013—0·014%), both as emulsion or wettable powder, tar oil (0·5% or 3·5%), and DDT (0·05%) emulsion gave efficient control of the leaf-curling plum aphid. A. H. CORNFIELD.

Virus diseases of fruit trees. IV. Further observations on rubbery wood, chat-fruit, and mosaic in apples. L. C. Luckwill (*A.R. agric. hort. Res. Sta. Bristol*, 1953, 40—46).—Rubbery wood virus was absent from seven Malling II stocks from different sources, whilst only two of six M.I. stocks tested were virus-free. Stocks M. I, II, VII, and IX (from Long Ashton) were free of chat-fruit virus, whilst IV, XII, and XVI were infected to varying degrees. Of 42 varieties tested against the vein-banding strain of apple mosaic, seven were tolerant, 13 partially tolerant, and 22 susceptible. Apple mosaic virus was not fully systemic in some varieties. A. H. CORNFIELD.

Parathion spray residue on apples and canned peaches. H. J. R. Dürr (*Fmg S. Afr.*, 1954, **29**, 231—232).—The fruit under investigation was twice sprayed with 15% Parathion wettable powder at 1½ lb. per 100 gal. of water. Apples showed 0·28 p.p.m. after three weeks and peaches 0·29 p.p.m. during canning. No taint could be detected. E. G. BRICKELL.

Seasonal weather influence on efficiency of Systox applications for control of mites on lemons in Southern California. L. R. Jeppson, M. J. Jesser, and J. O. Complin (*J. econ. Ent.*, 1954, **47**, 520—525).—All soil applications and winter trunk treatments with Systox were relatively inefficient against *Metatetranychus citri* and *Aceria sheldoni* on lemon trees. Systox sprays were more persistent to citrus red mite when applied during the winter than during the summer months. Summer trunk treatments were more effective than summer sprays against citrus bud mites. Reasons for variations in effectiveness of applications with the seasons are discussed. A. A. MARSDEN.

Blackcurrant leaf spot. I. Perennation and infection. A. T. K. Corke (*A.R. agric. hort. Res. Sta. Bristol*, 1953, 154—158).—Observations on perennation and infection are reported. In the field primary infections were observed mainly in May on the leaves surrounding the fruit clusters. Removing dead leaves in Feb. was more effective than ground spraying with 0·1% DNOC (during the dormant period) or plant spraying with 1·5% lime–sulphur in early

April in reducing the incidence of leaf spot up to the cropping date. Combining the three treatments was particularly effective in reducing infection. A. H. CORNFIELD.

Control of the cranberry fruitworm on blueberries. M. T. Hutchinson (*J. econ. Ent.*, 1954, **47,** 518—520).—Of 10 insecticides tested against *Mineola vaccinii* in a heavily infested blueberry field, Malathion, Methoxychlor, Endrin, and Parathion used as either wettable powder sprays or emulsions, gave excellent control of this pest. DDT was less satisfactory and Ryania relatively ineffective. Flavour evaluation tests showed that berries treated with compound Q-137 were the nearest in taste to untreated samples. A. A. MARSDEN.

The beet leafhopper. J. R. Douglass and W. C. Cook (*U.S. Dep. Agric.*, 1954, *Circ.* No. 942, 21 pp.).—Life history and habits are described. Control is best attained by the use of herbicides to reduce breeding areas. E. G. BRICKELL.

Cabbage maggot control in late cabbage. A. C. Davis, K. G. Swenson, and M. E. Patterson (*J. econ. Ent.*, 1954, **47,** 475—479).—Aldrin (6 lb), Dieldrin (3—4 lb.), and Heptachlor (3 lb. per acre) used as broadcast soil applications effectively controlled cabbage maggot in direct sowings of cabbage and plantings of radish. Chlorodane was less satisfactory. Dieldrin (8 lb.) gave satisfactory residual control of cabbage maggot in plantings of cabbage, and Aldrin and Dieldrin (8 lb. per acre) reduced maggot injury in rutabagas. Dieldrin applied (1 lb. per acre) in the seed furrows at the time of sowing gave promising results against this pest. A. A. MARSDEN.

Reduction of pea virus spread by insecticide applications. K. G. Swenson, A. C. Davis, and W. T. Schroeder (*J. econ. Ent.*, 1954, **47,** 490—493).—Three Parathion sprays used on large plots effectively reduced pea virus disease by controlling pea aphids. When the disease reduction reached 20% a definite economic gain resulted from the value of the increased yield of peas. A. A. MARSDEN.

Control of onion maggot on seed sets in the Connecticut Valley. A. H. Tozloski (*J. econ. Ent.*, 1954, **47,** 494—497).—When used as a seed protectant in the dry state, 10% DDT or 1% Dieldrin gave the most effective control of onion maggot, *Hylemya antiqua* (Meig.). Spraying for maggot control was not as effective and was less economical. A. A. MARSDEN.

Radiophosphorus in metabolism studies in the two-spotted spider mite. J. G. Rodriguez (*J. econ. Ent.*, 1954, **47,** 514—517).—P metabolism in *Tetranychus bimaculatus* Harvey was studied by feeding young female mites on radioactive bean leaves. Phosphorus in mite eggs was three times as concentrated as in the mite body: egg production, therefore, consumed relatively large quantities of P. Non-radioactive leaf discs became radioactive when fed on by radioactive mites, due to a P-containing secretion being injected into the leaf. A. A. MARSDEN.

Control of greenhouse whitefly and other insects on beans in Hawaii. M. Sherman, M. Tomashiro, and E. T. Fukunaga (*J. econ. Ent.*, 1954, **47,** 530—535).—Weekly sprays of Parathion (0·032) and EPN (0·063%) gave excellent control of the greenhouse Whitefly, *Trialeurodes vaporariorum*. Parathion (0·016), DDT (0·25%), Methoxychlor, Chlordane, Toxaphene, Dieldrin, and Aldrin also gave good control. EPN was equally effective when applied at weekly or bi-weekly intervals, but Parathion, Malathion, or CS-708 were more effective applied at weekly intervals. All materials tested effectively controlled the bean pod borer, *Maruca testulalis*, and the bean leafhopper, *Emposea solana*. A. A. MARSDEN.

Zinc increases susceptibility of bean leaves to tobacco mosaic virus. C. E. Yarwood (*Phytopathology*, 1954, **44,** 230—233).—Leaves of mosaic-infected bean plants showed more abundant lesions after dipping in aq. 0·001—0·03% $ZnSO_4$ or 0·1—1·0% $CaCl_2$. Similar effects resulted from inoculating detached leaves on the upper surface and incubating them with the under-sides in contact with 0·01—0·1% $ZnCl_2$ or 0·0003—0·003% $AgNO_3$. Dipping inoculated leaves in aq. 0·001—0·003% $AgNO_3$ generally prevented lesion formation. Zn treatments which increased the lesions on bean had the opposite effect on *Nicotiana glutinosa*. A. G. POLLARD.

Effect of Systox on some common predators of the cotton aphid. M. K. Ahmed, L. D. Newsom, R. B. Emerson, and J. S. Roussel (*J. econ. Ent.*, 1954, **47,** 445—449).—Three species of Syrphidæ fed on cotton aphids poisoned with Systox were highly susceptible in all larval stages. The susceptibility of larvæ of five species of Coccinellidæ varied from 100% in *Scymnus hæmorrhous* to 3·7% in *Coleomegilla maculata*. Adult *Coccinellidæ* were unaffected except *Cycloneda sanguinea* of which ~50% were killed. Larvæ of two species of *Chrysopa* were almost immune to Systox. A. A. MARSDEN.

Insecticides for cotton leafworm control in 1952 and 1953. C. R. Parencia, jun., C. B. Cowan, jun., and J. W. Davis (*J. econ. Ent.*, 1954, **47,** 541—542).—Ca arsenate, γ-$C_6H_6Cl_6$–DDT–S, Toxaphene–S dusts, and Toxaphene, Endrin, EPN, Isodrin, Parathion, Metacide, and Chlorthion sprays were all highly effective against *Alabama argillacea* for at least 48 hr. after application. A. A. MARSDEN.

Effect on beneficial insects of several insecticides applied for cotton insect control. R. C. Gaines (*J. econ. Ent.*, 1954, **47,** 543—544).—A single application of Dieldrin–DDT–S, Toxaphene–S, γ-$C_6H_6Cl_6$–DDT–S, γ-$C_6H_6Cl_6$–DDT–S or Ca arsenate for controlling cotton fleahoppers greatly reduced beneficial insects and spiders. A. A. MARSDEN.

Fungicides for treatment of diseases of the tapping panel [in rubber trees]. F. W. Hutchison (*Arch. Rubbercult.*, 1953 [May], Extra No., 136—140).—In the control of mouldy rot (*Ceratostomella fimbriata*) good results were obtained with cationic detergents, *e.g.*, tetradecylpyridinium bromide (Fexanol V.R., Fylomac 90) and cetyltrimethylammonium bromide (Lissolamine A). Addition of gentian violet (10%) to Fixanol V.R. delayed re-infection. HORT. ABSTR. (A. G. P.).

Forest pathology. XIV. Decay of Douglas fir in coastal region of British Columbia. C. P. Thomas and R. W. Thomas (*Canad. J. Bot.*, 1954, **32,** 630—653).—Irregularities in the occurrence of decay-producing fungi, and the amounts of decay produced, are influenced by: site, tree age or size, latitude, and stand history. Root infections occur most frequently, but branch-stub infections cause the greatest amount of decay. Some tree abnormalities (*e.g.*, sporophores and swollen knots of *Fomes pini*) indicate hidden decay. R. H. HURST.

Breakdown of timber by Ascomycetes and Fungi Imperfecti. J. G. Savory (*Ann. appl. Biol.*, 1954, **41,** 336—347).—The nature of the damage caused by soft rot in timber is described. Soft rot most often occurs in waterlogged wood but has been observed in fence posts, logs, and sawn timber. The species of fungi isolated from timber showing soft rot are tabulated. Attempts to induce soft rot by inoculation have generally proved unsuccessful, although extensive attack of hardwood by *Chætomium globosum* has been induced. Soft rot is an important cause of deterioration of the filling timbers in water-cooling towers. This problem is discussed. A. H. CORNFIELD.

Canker disease of cypresses in East Africa, caused by *Monochætia unicornis* (Cooke & Ellis), Sacc. III. Resistance and susceptibility of species of *Cupressus* and allied genera. D. Rudd Jones (*Ann. appl. Biol.*, 1954, **41,** 325—335).—A report of inoculation experiments with *Monochætia* on species of Cupressus and allied genera which are grown in E. Africa, with spec al reference to *Cupressus* species of commercial importance. A. H. CORNFIELD.

Effect of purines, purine analogues, and related compounds on the multiplication of tobacco mosaic virus. I. R. Schneider (*Phytopathology*, 1954, **44,** 243—247).—Formation of the virus in leaf disc cultures of tobacco was inhibited to varying extents by 8-azaguanine (**I**), 8-aza-adenine, 2-aza-adenine, 2 : 6-diaminopurine, benziminazole, 6-nitrobenziminazole, 2-ethyl-5-methylbenziminazole thioguanine, 2-methylthioadenine (**II**), and 2-iodoadenine. The inhibitive effects of **I** and **II** were reversed by adenosine or adenylic acid. Neither xanthine, hypoxanthine, nor *p*-aminobenzoic acid showed appreciable powers of reversal. The mechanisms of inhibitory and reversal actions are discussed. A. G. POLLARD.

Distribution of viruses in different leaf tissues and its influence on virus transmission by aphids. F. C. Bawden, B. M. G. Hamlyn, and M. A. Watson (*Ann. appl. Biol.*, 1954, **41,** 229—239).—Ultraviolet irradiation of leaves systemically infected with cabbage black ring spot virus (CBRSV) or henbane mosaic virus (HMV) decreased the infectivity of the sap to ~20% of that of sap from control leaves. Infectivity of tobacco mosaic virus in tobacco leaves was hardly affected by irradiation. CBRSV and HMV were transmitted most frequently by previously fasted aphids that fed for only short periods on infected leaves. Irradiation had little effect on transmissivity where prolonged feeding was allowed. There was an unequal distribution of readily extractable virus in different tissues of systemically infected leaves, the concn. being relatively high in epidermal cells. A. H. CORNFIELD.

Termites. H. Weidner (*Z. PflKrankh.*, 1954, **61,** 337—351).—A review. The physiology and nutrition of termites and methods for their control are discussed. Reference is made to specific termite problems in S. Africa and elsewhere. (116 references.) A. G. POLLARD.

Parasitisation of the salt-marsh caterpillar in Arizona. E. A. Taylor (*J. econ. Ent.*, 1954, **47,** 525—530).—Parasitisation of fifth-instar caterpillars of *Estigmene acrea* in the field was due to two species of tachinid flies, *Exorista larvarum*, and *Rileymyia adusta*. Adults of both species were easily killed by the usual cotton insecticides.

DDT killed the tachinid parasites within the caterpillars, which thus developed normally. Since DDT has little effect on this caterpillar, its use on cotton appears to have altered the relationship between the insect host and its enemies and favoured the development of large populations of the salt-marsh caterpillar. A. A. MARSDEN.

Control of insect pests of ornamentals. J. C. Schread (*J. econ. Ent.*, 1954, **47**, 498—500).—One treatment with Malathion or "Potosan" applied after the eggs had hatched effectively controlled oystershell scale, pine needle scale, and azalea bark scale. TEPP, nicotine sulphate, and "Loro" (lauryl thiocyanate) were also highly effective against azalea bark scale, but Lindane, Chlordane, Aldrin, or Dieldrin gave poor control of young scales. Malathion controlled birch leaf miner at dilutions of 1 : 200 to 1 : 1600, and boxwood leaf miner at a dilution of 1 : 400. G-23611 (1-*iso*propyl-3-methylpyrazol-5-yl dimethylcarbamate), Malathion, and $C_6H_6Cl_6$ gave excellent aphid control on English hawthorn. A second application of the latter two materials was necessary to prevent severe aphid populations at the end of the summer. A. A. MARSDEN.

Systemic phosphorus compounds for pests of ornamental plants. J. Fjeldalen (*Gartneryrket*, 1953, **43**, 295—297).—Successful control of aphids on cineraria and cyclamen and of *Tetranychus althææ* on carnation was obtained with Pestox. In addition to these Systox also controlled *Ditylenchus dipsaci* on hydrangea, *Pseudococcus maritimus* on fuchsia and *Lecanium hespeirdum* on *Hedera canariensis*. In summer spraying protected the plants for 2—3 weeks and watering into the soil was effective for 5—6 weeks. HORT. ABSTR. (A. G. P.).

Biology and control of *Brevipalpus inornatus*, (Banks). F. S. Morishita (*J. econ. Ent.*, 1954, **47**, 449—456).—Emulsions of Chlorobenzilate and DMC (25%) or a wettable powder suspension of Diazinon (25%) gave very good control of the privet mite. Aramite and Ovotran gave better control than did Toxaphene, rotenone, or Malathion. A. A. MARSDEN.

A parasitism mechanism of the kenaf anthracnose organism related to the hydrogen ion concentration in the tissues of the host. F. D. Venning and B. S. Crandall (*Phytopathology*, 1954, **44**, 465—468).—The kenaf (*Hibiscus cannabinus*, L.) anthracnose organism, *Colletotrichum hibisci* secretes alkaline substances. The aerial tissues of kenaf are generally acid (pH 4—6). Probably a preliminary to parasitism is the raising of the pH of the host tissue to alkaline levels. This causes disruption and necrosis after which penetration of the tissues by *C. hibisci* occurs. T. G. MORRIS.

Secretion of α-amylase by *Rumex* virus tumours *in vitro*. L. G. Nickell and M. K. Brakke (*Amer. J. Bot.*, 1954, **41**, 390—394).—The secretion of extra-cellular α-amylase by virus tissue of sorrel (*Rumex acetosa*) placed in a liquid medium is not due to cellular breakdown: it decreased very rapidly after two days. Excised normal roots did not secrete amylase. In contrast to the virus tissue crown gall tissue from other plant species did not readily utilise starch supplied as sole C source. The bearing of these observations on the mechanism of the secretion process in *Rumex* is considered. A. G. POLLARD.

Toxicity to worker honey-bees (*Apis mellifera*, L.) of chemicals used in plant protection. G. D. G. Jones and J. U. Connell (*Ann. appl. Biol.*, 1954, **41**, 271—279).—The effectiveness as stomach and contact poisons against the worker honey-bee decreased in the order Parathion, TEPP, γ-$C_6H_6Cl_6$, Dieldrin, Aldrin, Chlordane, Systox, bisdimethylaminofluorophosphine oxide, Toxaphene and 2 : 4-D and MCPA (Na salts); as residual films Dieldrin, Aldrin, γ-$C_6H_6Cl_6$, Parathion, Chlordane, and Systox (other materials had no measurable effect); as fumigants Dieldrin, γ-$C_6H_6Cl_6$, Aldrin, Parathion, and Chlordane, others had no measurable effect. A. H. CORNFIELD.

Total composition of hay. II. Hemicellulose and cellulose determinations. N. Hellström (*Acta agric. scand.*, 1954, **4**, 209—223).—Hay freed from fat, sugar, and proteins was studied by extraction with alkali of different concn. and by acid hydrolysis. Guinier *X*-ray photographs were made of the cellulose prep. Results suggest that cellulose is surrounded by matrix substances, the swelling of which is important in relation to dissolution and hydrolysis. E. G. BRICKELL.

Feeding value of red clover conserved as hay and as silage in respect of milk production. C. F. Huffman, C. W. Duncan, S. T. Dexter, and C. M. Chance (*Mich. agric. Exp. Sta. Quart. Bull.*, 1954, **36**, 391—400).—Clover hay and silage showed the same contents of protein and N-free extract (dry basis), coeff. of digestibility of dry matter, crude fibre and N-free extract and contents of digestible protein and total digestible nutrients. The silage contained less crude fibre but more Et_2O-extract and carotene and showed lower digestibility coeff. for protein and higher coeff. for Et_2O-extract. No differences between hay and silage were apparent in respect of milk production, body-wt., consumption of digestible nutrients, or as sources of undefined lactation factors. A. G. POLLARD.

Nutritive value of maize silage for milking cows. C. F. Huffman and C. W. Duncan (*J. Dairy Sci.*, 1954, **37**, 957—966).—Replacement by maize silage of part of the hay in an all-hay ration of cows depleted of their milk-producing factors resulted in an increased production of fat-corrected milk per lb. of total digestible nutrients (TDN) consumed; % of butter fat in the milk and body wt. of the cows were not significantly affected. The grain in maize silage contributes the unidentified grain factor(s) necessary to balance TDN in roughage; maize silage therefore is not a true roughage, but a mixture of roughage and grain. S. C. JOLLY.

Napier grass (*Pennisetum purpureum*) meal, a substitute for lucerne meal in chick starter rations. M. M. Rosenberg (*Poultry Sci.*, 1954, **33**, 803—809).—When added to chick starter rations at the 5% level, Napier grass meals were as effective as was lucerne meal (5% level) in promoting growth of the birds. Since Napier grass can be grown easily in the tropics, it should be a cheap and effective substitute for lucerne, which can be grown only with difficulty under tropical conditions.. A. H. CORNFIELD.

Two components of cottonseed that cause discoloration in eggs. B. W. Heywang, H. R. Bird, and F. H. Thurber (*Poultry Sci.*, 1954, **33**, 763—767).—The factor(s) causing pink albumin of eggs (a trouble distinct from discoloration caused by gossypol) during storage was present in relatively high concn. in crude cottonseed oil, in raw cottonseed and cottonseed pigment glands, but not in cottonseed hulls. It was present in cottonseed meal extracted with hexane but not in that extracted with methyl ethyl ketone or *iso*butane. The incidence of pink albumin increased with storage time. The yolks of eggs of birds fed diets high in gossypol had a high degree of gossypol-type discoloration. Both types of discoloration were found in eggs laid on the third day after the diets were first fed. A. H. CORNFIELD.

Assay of feedstuffs and concentrates for vitamin B_{12} potency. R. H. Lillie, H. R. Bird, J. R. Sizemore, W. L. Kellogg, and C. A. Denton (*Poultry Sci.*, 1954, **33**, 686—691).—The vitamin B_{12} potency of a variety of feedstuffs and concentrates used in poultry feeding was determined by both a chick assay method and the U.S.P (1950) microbiological assay method. Fish meals usually showed similar B_{12} contents by both methods, whilst fish solubles showed higher values by the chick method. Some sewage sludge prep. showed a higher B_{12} potency by the microbiological method, whilst some commercial B_{12} concentrates, liver extracts, meat meal, and grass juice showed higher values by the chick method. A. H. CORNFIELD.

Effects of selenium, arsenicals, and vitamin B_{12} on chick growth. C. W. Carlson, E. Guenthner, W. Kohlmeyer, and O. E. Olson (*Poultry Sci.*, 1954, **33**, 768—774).—The growth of chicks receiving a diet containing Se 10 p.p.m. was not affected up to four weeks of age. Arsanilic acid (**I**) and 3-nitro-4-hydroxyphenylarsonic acid (0·01% in the feed) stimulated the growth of birds both in the presence and absence of added Se. Toxicity symptoms due to Se became marked only where vitamin B_{12} was supplied, severe growth reductions occurring when Se (10 p.p.m.) was added to the diet. Both $NaAsO_2$ (10 p.p.m. As in the diet) and **I** (0·01% in the diet) counteracted, to a certain extent, the toxic effects of Se. There were varietal and strain differences in both tolerance of Se and response to As compounds. A. H. CORNFIELD.

Deficiency of folic acid in rations containing natural feedstuffs. H. C. Saxena, G. E. Bearse, C. F. McClary, L. G. Blaylock, and L. R. Berg (*Poultry Sci.*, 1954, **33**, 815—820).—Maize–herring meal rations were deficient in folic acid for chick growth to four weeks of age, causing poor growth, poor feathering, and perosis. Satisfactory growth was obtained when folic acid (50 μg. per 100 g. of feed) or natural feedstuffs which contained folic acid (dehydrated grass, brewer's yeast, soya-bean oil meal, or liver meal) were added to the diet. A. H. CORNFIELD.

Effect of penicillin on the growth and feed consumption of turkey poults. S. J. Slinger and W. F. Pepper (*Poultry Sci.*, 1954, **33**, 746—753).—For birds fed *ad libitum* the addition of penicillin (15 p.p.m. in the feed) to the diet resulted in greater feed consumption per poult per day for the entire period. On the unit body wt. basis the antibiotic enhanced feed intake to 6 days, had little effect from 6 to 17 days, and reduced feed intake from 17 to 25 days. Growth stimulation due to the antibiotic was greater with birds given free choice of feed than with those on equalised feed intake. The effect of penicillin in stimulating growth of poults can be explained largely on the basis of increased feed consumption per unit of body wt. which occurs during the first week of life. A. H. CORNFIELD.

Microbiological observations on the antibiotic-fed chick. J. M. Sieburth, J. J. Jezeski, E. G. Hill, and L. E. Carpenter (*Poultry Sci.*, 1954, **33**, 753—762).—Supplementation of the feed of chicks with antibiotics (penicillin, aureomycin) resulted in a decrease in the no. of all types of cultivable microflora studied and reduced the respiration rate of the contents of the small intestine and the odour of the fæces and intestinal contents. The treatment also caused the mesenteric blood vessels along the small intestines to become more prominent and dilated. A. H. CORNFIELD.

Influence of treatment and fertility level of semen on distribution and non-return decline of repeat service intervals. F. H. Flerchinger and R. E. Erb (*J. Dairy Sci.*, 1954, **37**, 949—956).—The use of penicillin, penicillin–streptomycin, and penicillin–streptomycin–sulphanilamide combinations did not significantly affect the average length of return to service interval (*S*). Bulls of lower fertility had a lower *S* than had bulls of higher fertility, due chiefly to a higher % of repeat services recurring from 17 to 26 days in the low fertility groups. S. C. JOLLY.

2.—FOODS

Effect of storage on chemical composition of husked, undermilled, and milled rice. M. Narayana Rao, T. Viswanatha, P. B. Mathur, M. Swaminathan, and V. Subrahmanyan (*J. Sci. Food Agric.*, 1954, **5**, 405—409).—Changes are reported in raw husked rice (*H*), raw undermilled rice (*U*) containing 1·8 μg. of thiamine per g., parboiled rice (*P*), and raw milled rice (*M*) stored for one year in gunny bags. Amylase activity in freshly harvested rice decreased rapidly, N sol. in 3% NaCl solution decreased (probably due to protein denaturation), cooking quality improved, acidity and peroxide val. of the fat increased (particularly in *H*), and, in all samples except *P*, thiamine decreased by ~20—30%. The estimated storage life, based on organoleptic tests and peroxide val., was 7 months for *H*, 12 for *U*, 11 for *P*, and 13 for *M*. S. C. JOLLY.

Soya-bean products as supplements to rice in Chinese diets with special reference to their protein and calcium content. Yet Oy Chang (*Dissert. Abstr.*, 1954, **14**, 1201).—The products tested were (*a*) dried yellow soya-beans, (*b*) soya-bean curd, (*c*) soya-beans, fermented, (*d*) soya-bean fermented curd. Rats (132) each weighing 44—45 g. were given experimental diets for 26 weeks, nine different diets being tested. The soya-bean curd diet gave the best results for growth and calcification, this diet providing 23·2% of total protein and 0·17% of Ca. The use of soya-bean curd is recommended in parts of the world where animal proteins are in short supply and the Ca of the diet is low. E. M. J.

Milling of sorghum in Nigeria. W. D. Raymond, J. A. Squires, and J. B. Ward (*Colon. Plant Anim. Prod.*, 1954, **4**, 152—158).—Experimental commercial milling of sorghum is described; analytical data for thiamine, nicotinic acid, riboflavin, P, and protein contents in the flours, middlings and offal are given; and consumer acceptance trials with Nigerian natives are discussed. G. HELMS.

Occurrence of factors which inhibit oxidation of L-ascorbic acid. I. Oats. H. Janecke (*Dtsch. Lebensmitt.-Rdsch.*, 1954, **50**, 65—69).—A water-soluble substance in hulled oats which prevents the copper-catalysed oxidation of ascorbic acid is described. It contains P, N, and carbohydrate (fructose); fructose alone, trifructosan, and amino sugar are devoid of this activity. FOOD SCI. ABSTR. (R. B. C.).

Temperature of popper in relation to volumetric expansion of popcorn. W. A. Huelsen and W. P. Bemis (*Food Technol.*, 1954, **8**, 394—397). E. M. J.

Preparation of semolina-like product from soft wheat. G. Rama Rao and M. Swaminathan (*J. sci. industr. Res. India*, 1954, **13, A**, 379—381).—A simple process for preparing a semolina-like product from soft wheat is described. The following steps are involved: (1) cleaning and soaking, (2) steaming and drying, (3) polishing, and (4) grinding and grading. G. C. JONES.

Manufacture of wheat starch: use of centrifugal separators. D. Müller-Mangold (*Stärke*, 1954, **6**, 159—168).—The use is discussed of centrifugal separators instead of conventional starch tables in the manufacture of wheat starch. The disadvantage of greater power consumption is outweighed by smaller size of machine, possibility of continuous working without attention, a more uniform product and the possibility of fractionating the starch into two parts of different grain size. A flow-sheet and 26 micro-photographs are included. E. DUX.

Damage to starch in the milling flow-sheet. P. F. Pelshenke and G. Hampel (*Getreide u. Mehl*, 1954, **4**, 1–4).—Factors which affect the starch granules in cereal grains during various stages of the milling process were investigated. A total of 285 passages was examined before and after the breaks in the flow-sheet, and the extent of mechanical damage to the starch granules was assessed by a method based on Hampel's amylose number; the damage attributable to each break was expressed as the difference of the two values. Even the first break can cause marked damage to the starch granules, due to destruction of the endosperm structure. Damage in the bran centrifugals is hardly noticeable in the flow-sheet, since the % of flour in this passage is small. In the cleaning machines and in the husking brush machines, starch deformation is negligible. The amylose number was found to be increased by stronger leading; considerable damage can also be caused by the setting of the fluted rolls. The extent of the damage to starch depends primarily on the hardness of the endosperm; soft wheats gave higher amylose values than the hyaline types. FOOD SCI. ABSTR. (R. B. C.).

Starch damage and kernel hardness. P. F. Pelshenke and G. Hampel (*Getreide u. Mehl*, 1954, **4**, 9—12).—The amylose numbers of different types of wheat (grist) were examined; values were 55 for German home-grown wheat, 177 for hard winter wheat, and 310 for durum wheat. A comparison of the amylose numbers of the milled flours showed a further differentiation, especially between the medium-hard and hard types of wheat. The degree of fineness of flour from the breaks of a conical mill was directly related to the degree of hardness of the endosperm. Data are presented on the effect of water content on the damage to the starch granules. Starch damage depends greatly on the water content of the endosperm. FOOD SCI. ABSTR. (R. B. C.).

Scientific and technical progress in the control of bread diseases. P. F. Pelshenke (*Brot u. Gebäck*, 1954, **8**, 27—32).—The highest % losses due to the presence of micro-organisms occur in sliced bread; losses are lower in dark-brown (black) and wholemeal bread, and lowest in white bread and small baked goods. In bread, mould growth and ropiness are the main forms of spoilage which must be controlled. Chemical preservatives which are more or less successful in bread include benzoic acid, formic acid, propionic acid, and their salts and esters. Other means for removal or prevention of moulds in bread include treatment of the bread surface with salicylic acid or acetic acid, heat sterilisation, suitable wrapping materials, u.v. irradiation, dipping in plastics (as yet undeveloped), and addition of antibiotics. The resistance of the Mesentericus group still presents difficulties, but strict modern hygienic precautions and the introduction of propionic acid or diacetic acid, and also acetate, have helped to reduce greatly the occurrence of ropiness in bread. FOOD SCI. ABSTR. (R. B. C.).

Chronic toxicity of bread additives to rats. W. D. Graham, H. Teed, and H. C. Grice (*J. Pharm. Pharmacol.*, 1954, **6**, 534—545).—Bread containing 50 times the normal concentration of ClO_2, propyl gallate, butylated hydroxyanisole, *poly*oxyethylene monostearate, of Na propionate as 75% of the diet for one year did not harmfully affect growth or mortality of rats. J. CALEY.

Browning of canned bread crumb. R. A. Larsen, R. B. Koch, and J. J. McMullen (*Food Technol.*, 1954, **8**, 355—357).—When stored for long periods the crumb becomes brown as a result of the Maillard reaction. The browning is minimised by using no sugar in the bread recipe, but bread contains carbohydrate reducing groups which are constantly being replenished by enzyme action prior to baking. E. M. J.

Science and the baker. J. B. M. Coppock (*Chem. & Ind.*, 1954, 1306—1311).—A lecture dealing chiefly with the scientific aspects of the uses in bread manufacture of mineral oils, fats, and monoglycerides. H. S. R.

Continuous process for glucose manufacture. O. Borud (*Stärke*, 1954, **6**, 148—152).—A review is made of practical experience obtained with the fully automatic Krøyer process. The plant yields 20 tons/24 hr. of high-quality syrup. Short conversion time (3½ min.) and automatic pH control ensure great uniformity of product. (See also K. Krøyer, *ibid.*, 1954, **6**, 119.) (12 references.) E. DUX.

Radio-isotopic dilution analysis for D-glucose and gentiobiose in hydrol. J. C. Sowden and A. S. Spriggs (*J. Amer. chem. Soc.*, 1954, **76**, 3539—3541).—A radio-isotopic dilution method is used to determine the content of D-glucose and gentiobiose (using ^{14}C-labelled sugars) in a representative sample of hydrol (a residual syrup obtained after the commercial crystallisation of D-glucose from acid hydrolysates of maize starch). The value obtained for the D-glucose content agrees well with that obtained by a direct isolation method; the value for the gentiobiose content is ⩾ that reported previously. A. JOBLING.

Phase equilibrium in sugar solutions. I. Ternary systems of water–sucrose–inorganic salts. II. Ternary systems of water–sucrose–hexose. III. Ternary systems of water–hexose–inorganic salts. IV. Ternary systems of water–glucose–fructose. V. General conclusions. F. H. C. Kelly (*J. appl. Chem., Lond.*, 1954, **4**, 401—404,

405–406, 407—408, 409—411, 411—413).—I. Ternary diagrams at 30° for the systems water–sucrose and KCl, NaCl, $MgSO_4$, $CaCl_2$, CdI_2, or $CuSO_4$ are studied. From a comparison of the compositions of the solution at the invariant point (I.P.) it is deduced that this composition is influenced more by the solubility of the second solute. Where the solubility of the second solute is low, *e.g.*, $CuSO_4$, the " purity " of the solution at the I.P. with respect to sucrose is high and *vice versa*.

II. Results for the two ternary systems water–sucrose–glucose and water–sucrose–fructose at 30° are presented. The conclusion reached in the first paper that the composition of the solution at the I.P. is influenced more by the solubility of the second solute than by any other factor is confirmed, *e.g.*, the solution at I.P. contained very much less sucrose in the presence of fructose than in the presence of glucose. No indication of double salt formation was obtained.

III. Results for the ternary systems water–glucose–KCl and water–fructose–KCl are presented. The solubility of both glucose and fructose in water is increased by the addition of KCl : fructose is affected more than is glucose.

IV. The ternary diagram at 30° is presented for the system water–glucose–fructose. An area of the diagram is found in which anhyd. glucose is the solid phase. The transition point (50°) between glucose hydrate and anhyd. glucose is reduced to something lower than 30° for solutions saturated with fructose. Although fructose exercises a salting-out effect for glucose in most of the saturated glucose solutions, at the I.P. the solubility of glucose is higher than in absence of fructose. Fructose shows no tendency to form a hydrate.

V. The following conclusions are drawn from an analysis of the results reported in papers I—IV : (1) the less the second solute influences the solubility of sucrose the lower the solution " purity " at the I.P., NH_4NO_3 being an exception ; (2) solutes that form a hydrate have a salting-out effect on sucrose and *vice versa* ; (3) the greater the influence of sucrose on the solubility coeff. of the second solute, the greater the proportion of that solute at I.P., with fructose as an exception ; (4) the primary factor limiting the crystallisation of sucrose from a solution with a second solute is the solubility of the second solute. R. J. MAGEE.

Calculation of the integral attenuation index between 400 and 700 millimicrons and of corresponding wave-length for filtered raw sugar solutions. F. W. Zerban and L. Sattler (*Analyt. Chem.*, 1954, **26**, 1363—1365).—An investigation was carried out to determine what single wavelength yields attenuation indices which correlate best with an average, obtained from all wave-lengths that can contribute to colour within the visible spectrum. From transmittancy data for 97 raw sugars, the curve of attenuation indices was plotted against λ for each solution and averaged over the λ range 400 to 700 mμ. Then the wave-length at which the solution has an attentuation index equal to the average was read by interpolation. The mean λ for all 97 samples was 505·3 mμ. the standard deviation being $\simeq$2·6%. The approx. average measure of the concn. of colouring matter in raw sugars may be determined therefore using λ 505 mμ. G. P. COOK.

Sugar cane processing. Clarification of new varieties of cane on a pilot-plant scale. W. F. Guilbeau, J. G. Lipps, jun., and L. F. Martin (*J. Agric. Food Chem.*, 1954, **2**, 941—946).—Equipment and procedures are described for grinding and processing 2-ton samples of cane on a pilot-plant scale. The evaluation of the suitability of seven new varieties for commercial use is reported. S. C. JOLLY.

Discussion of factors for quality control of sugar beet. M. Drachovská and K. Šandera (*Listy Cukr.*, 1954, **70**, 149—152).—The relations between analytical data for beets, diffusion juice, thin and thick juices, and beet quality are discussed. Calculated white sugar and molasses yields are compared with statistical and factory data. The relation between ash content in beet and the molasses yield is calculated. The factors are used to classify different types of beets. The Ca salts content in thick juice can also be used for beet quality control. SUG. IND. ABSTR. (E. M. J.).

Precipitation of colloids from juices with iron salts. Z. Czerwiński and Z. Drabent (*Gaz. Cukr.*, 1954, **56**, [4/6], 4—6).—Laboratory-prepared and factory beet diffusion juices, diluted to 10% dry solids, were treated with varying amounts of 5% solutions of $FeCl_3$, $Fe_2(SO_4)_3$, $Fe^{III}NH_4$ sulphate, or $FeSO_4$, heated to 85° for 15 min., and then centrifuged at 1200 r.p.m. The colloids in the original juices and in the centrifuged juice were determined as total, hydrophilic, and hydrophobic colloids by Dumanski's alcohol–ether method and by nephelometry. The pH of the juice before centrifuging was measured. The amount of colloid removal by the iron salts was greatest with $FeCl_3$, and decreased in the order given above, at pH 3·6—4·7 (isoelectric point of the colloids ?) a suitable amount of iron salt being added. Pptn. was less satisfactory at higher Brix values of the juices. SUG. IND. ABSTR. (E. M. J.).

Pressure losses in diffusion battery. F. Hruška, E. Slavíček, and M. Vender (*Listy Cukr.*, 1954, **70**, 137—139).—Measurements with different manometers indicated that of the total pressure difference 10% is used to overcome resistance on the screens, 20% in cossettes, 40% in interconnecting apparatus, and the rest in water and juice piping and on dirt catchers. Conical screens with side openings have a pressure drop per unit flow area which is 26% lower than usual, but as the size of this (Wallig) screen is limited the total pressure loss is 46% higher than usual. Losses in different parts of the piping, etc. are further analysed and possibilities of improvement are discussed. Increase of cossette thickness is limited by deleterious effect on extraction. The size of interconnecting pipes could be increased to reduce pressure losses ; the use of pumps between diffusers or an increase of the total pressure on the battery would increase throughput. SUG. IND. ABSTR. (E. M. J.).

Technology of circulation in the [beet] diffusion station. P. Wertan (*Cukoripar*, 1954, **7**, 109—111).—An increase in the size of diffusers allows larger amounts of cossettes to be processed, but juice quality may be affected ; diffusion rate should not be slower. With greater capacity, the pressure drop is reduced. A method of measuring the pressures is described. A water pressure of about 1 m. is available per vessel ; 0·25—0·5 m. pressure drop was measured on the empty vessel and ancillary piping, so that 0·5—0·75 m. drop is available for overcoming cossette resistance. Coeff. are calculated according to Dehn's formula as $K = 1000Ls$, where L = effective total cossette height in m. (*i.e.*, in each vessel × no. of vessels), and s = theoretical juice speed in cm./sec., calculated as quantity of raw juice divided by sieve area. The value of K should be $\geqslant$35. In 11 factories, only two satisfied this condition. Practical considerations are discussed ; the question of side or bottom emptying of diffusers is considered. SUG. IND. ABSTR. (E. M. J.).

Re-utilisation of water in [beet] juice production. E. Reinefeld (*Zucker*, 1954, **7**, 262—270).—Diffusion and pulp-press water is disinfected with Cl (4—10 mg./l.) and/or formalin. If condensate is also used the alkalinity of the condensate is neutralised with H_2SO_4 (200—400 g. conc. H_2SO_4 per cu. m. of condensate). Swedish practice is compared. Juice purities are not affected by the returned water, and results of tests in the Braunschweig Inst. indicate that juice quality is not deteriorated, figures for saturation juice and thick juice by fresh water and returned water operation being compared. The pulp from returned water operation contains a higher proportion of dry solids, and the yields on beets are 10% higher than with fresh water diffusion : comparisons are tabulated. The advantages and disadvantages of methods of the return of the water are discussed, in a tower diffuser or in a battery or by a combination of these methods. With water re-utilisation there may be increased " pressure " or resistance to flow ; improvement in cossette quality is necessary. Diffuser design, particularly the shape and size of the bottom sieve, is considered in relation to juice flow and extraction efficiency, Wiberg's work and Dehn's concept of the " diffusion characteristic " being discussed. SUG. IND. ABSTR. (E. M. J.).

Purification of diffusion- and pulp-press waters by liming and carbonatation for re-utilisation. Influence of returned water on work of diffusion. T. Pietrzykowski, A. Kintzel, and S. Godwood (*Prace Głownego Inst. Przemysłu Rolnego i Spożywczego*, 1953, **3**, [4], 1—9).—Water re-utilisation at Chybie factory during ten days at the end of season are described. Pulp-press water was strained, defecated with 0·1—0·4% of lime (on wt. of water), carbonatated, filtered in presses, mixed with diffusion water, which had been filtered separately, and returned to the battery. For optimum filtration 0·3% of lime was best. Results indicated no difference with cold (50°) and hot (70—90°) carbonatation, if filtration was carried out at 70° Removal of non-sugars was 65—88%. Analytical data from the battery operation and for subsequent processing stages are given. Sugar losses in diffusion were reduced by 0·13% (and might be better with greater pressing of the pulp), but draw-off had to be increased, reducing juice Brix by 1—2°, and increasing steam consumption and reducing throughput. Juice and ultimate sugar qualities were not affected. SUG. IND. ABSTR. (E. M. J.).

Current problems of the sugar industry. XI. Final alkalinity and lime content of juices. V. Sázavský (*Listy Cukr.*, 1954, **70**, 128—130).—In factory operation, the presence of excess lime did not affect subsequent evaporation, and better results were achieved when soda was not used for adjustment of the alkalinity of beet juice and which also leads to greater molasses formation. The function of second saturation is to adjust the Ca^{++} concn. so that sufficient alkalinity remains in the thick juice and massecuite ; some lime may even be added. If first saturation is taken to 0·08% of lime alkalinity, then after exact second saturation there is no effect achieved by the rest period, since no excess Ca is present. Second saturation should therefore be taken to a point above optimum alkalinity ; on boiling, the vapours then contain less uncondensable

gases, and the condensate contains less CO_3" and is more suitable for sweetening-off muds. SUG. IND. ABSTR. (E. M. J.).

Rheological measurements on sugar solutions, cacao butter, edible fats, and couvertures. J. Kleinert (*Zucker u. Süsswaren-Wirtschaft*, 1954, **7**, 469—471, 511—517).—The Drage structure-viscometer which is described and illustrated was used to determine the viscosities and flow curves of sucrose solutions of 61·9—67·2% concn. at 20°, and of cacao butter, coconut and " biscuitine " fats, cocoa paste and fondant couvertures. Results are given in tables and graphs, and changes in composition, temp., etc., are discussed. SUG. IND. ABSTR. (E. M. J.).

Problem of humidity in the storage of refined sugar and its control. G. Mantovani (*Ind. sacc. ital.*, 1954, **47**, 108—114).—The effects of temp. humidity and micro-organisms, the risks of caking, and the bulk storage of sugar are discussed with reference to the literature. An apparatus for the rapid determination of moisture in sugar is described. The sugar is weighed on to a Gooch crucible which is fitted into the top of a tube leading out of a small oven. Air entering the oven at the other end, through a Pyrex tube carrying an electric heating coil, is sucked through the sugar sample by a pump; the temp. of the air is controlled, and the sugar can be dried in 25—30 min. or less: the sugar is cooled in a desiccator and weighed. SUG. IND. ABSTR. (E. M. J.).

Chemical engineering in the food industry. Bulk storage and transport of sugar. E. T. Moss (*Chem. & Ind.*, 1954, 1189—1194).—Raw sugar is now shipped to Great Britain from the West Indies in bulk and unloaded with a 4-ton grab at the rate of up to 200 tons per hr. Approx. 40,000 tons are stored at the London refinery in a single steel silo of the pressure type, 90 ft. high and 160 ft. in diameter, insulated on the outside with glass-wool mats, 3 in. thick, to prevent caking which results from variations in temp. causing moisture to be pptd. on the sugar, making it sticky. Refined sugar can be transported in Al alloy road tankers (capacity 12—13 tons) provided it is thoroughly cooled before loading, *e.g.*, in a rotary-louvre-cooler, in a water-cooled tubular cooler, or a stainless-steel band conveyor resting on a water surface. All three systems have certain drawbacks. The tanker discharges into storage hoppers with a ratio of height : diameter of $<1{\cdot}5:1$ to eliminate " plug-type " flow of the sugar down the walls of the hopper which causes abrasion. J. M. JACOBS.

Determination of the total electrolyte concentration of sugar products. J. Pomeranz and C. Lindner (*Anal. chim. Acta*, 1954, **11**, 239—243).—Solutions (8% wt./vol.) of brown sugar are poured through a column of Amberlite IR-120 cation-exchange resin and the effluents are titrated with 0·1N-NaOH using phenolphthalein as indicator. The titres are corrected for any original acidity of the solution. The results from 32 samples from various countries show an approx. linear relationship betwen the results obtained by this method and the results of ash determinations. W. C. JOHNSON.

Use of gas in sugar confectionery. H. Capper (*Industrial Gas*, 1954, **17**, 332, 335, 336, 338, 340, 341).—Gas-fired boilers, tables, glucose storages, and chocolate dipping tanks are described. T. H. BLAKELEY.

Comparison of some varieties of fruit preserved by bottling and by freezing. A. Crang and M. Sturdy (*A.R. agric. hort. Res. Sta. Bristol*, 1953, 199—205).—Bottled gages and plums were generally superior in quality to frozen fruit. Frozen raspberries were superior in colour and texture to bottled fruit although flavour was similar with both methods. Norfolk Giant was the best variety for freezing. A. H. CORNFIELD.

Concentration of strawberry juice. L. H. Walker, G. H. Notter, R. M. McCready, and D. C. Patterson (*Food Technol.*, 1954, **8**, 350—352).—Gelation of single-strength strawberry juice was caused by de-esterification of pectins. A clear non-gelling concentrate was prepared from strawberry juice treated with a pectic-enzyme prep. to permit clarification to a sparkling juice. A process was developed to produce depectinised concentrate up to 12-fold concn. by vol. Max. temp. during concn. was 100°F. (1·9 in. of Hg). E. M. J.

Effect of sucrose and ascorbic acid on quality retention in fresh and frozen strawberry puree. D. G. Guadagni (*Food Res.*, 1954, **19**, 396—401).—Deteriorative changes in the quality of fresh puree occur within two to three hours at room temp. and sucrose in a (4 + 1) ratio neither prevents nor minimises these changes. In frozen purees, the addition of sucrose or ascorbic acid offered no advantages with respect to quality retention during freezing, storage and defrosting. (12 references.) E. M. J.

Sclereid development and the texture of Bartlett pears. C. Sterling (*Food Res.*, 1954, **19**, 433—443).—Sclereid development occurs in both flesh and skin, more being formed in the skin and just outside the ovary. The initial sclereid is a nucleus for formation of new sclereids from adjoining parenchymatous cells. Serial concentric divisions in parenchyma cells surrounding the small sclereid cluster produce radiating files of cells, from which new sclereids differentiate at the surface of the sclereid cluster. (30 references.) E. M. J.

Factors influencing the quality and texture of frozen cultivated blueberries. E. E. Anderson and W. B. Esselen (*Food Technol.*, 1954, **8**, 418—421).—The effect of various packing media—water, sucrose syrups, and " dry " sugar on the fruit is discussed. (16 references.) E. M. J.

Mineral constituents in fruits. A. Hartmann (*Schweiz. Z. Obst- u. Weinb.*, 1954, **63**, 123—125).—Data for the contents of K, Na, Ca, Mg, Fe, Cu, Mn, P, S, and Cl in grapes, cherries, blackcurrants, plums, pears, and apples are tabulated. Much more K than Na is found in fruits generally; there is little Ca and relatively little Fe. FOOD SCI. ABSTR. (R. B. C.).

Protection of citrus fruits during transport and in storage. C. Moreau (*Fruits*, 1954, **9**, 51—59).—The fungi chiefly responsible for citrus rots are described. Their growth is favoured by deficient nutrition of the tree, wet seasons, rough handling, and high temp. and humidity during transport and storage. Prevention requires good cultural practices, careful handling, control of temp. and humidity, and precautions to avoid infection. Paper wraps are valuable. The use of fungicides is discussed. FOOD SCI. ABSTR. (R. B. C.).

Drying of vine fruits. F. Penman and F. S. Oldham (*J. Dep. Agric. Vict.*, 1954, **52**, 57—67).—The most suitable times and methods of harvesting, and the procedure for drying vine fruits for the prep. of currants, sultanas, and raisins are described. For sultanas, the formulæ and equipment for using cold, mixed, and sulphite dips, and the relative merits of these dips, are discussed; the method of loading the fruit on to racks, and the formulæ and applications of sprays during drying, are given. No dips or sprays are used for currants. Both currants and sultanas, while on the racks, should be shaded from the sun and protected from rain until all berries are dry, then shaken down and spread out. A plain NaOH dip is recommended before drying lexias, as this produces a tough skin, which is desirable for subsequent removal of seeds. Small quantities of the best grapes may be sun-dried for the production of table raisins, which, however, are usually dehydrated in packing-houses. Details are given of the structure, constructional materials, erection, and use of satisfactory racks. FOOD SCI. ABSTR. (R. B. C.).

Preparation of green olives. XI. Use of pure lactobacillus cultures. J. M. R. de la Borbolla y Alcalá, C. Gómez Herrera, and A. Izguierdo Tamayo (*An. real Soc. esp. Fis. Quím.*, 1954, **50, B**, 497—504).—Inoculation at an early stage of the pickling improves the quality and keeping properties of green olives. In some cases inoculation together with the addition of fermentable material improves olives which have deteriorated on long conservation. Similarly olives in which fermentation has been retarded may be improved. L. A. O'NEILL.

Use of coating for extension of storage life of fresh Fajli mango. A. N. Bose and G. Basu (*Food Res.*, 1954, **19**, 424—428).—The fruit was coated (*a*) by dipping in a paraffin bath at 80° for 10 sec. and (*b*) dipping in 50% solution of paraffin in light petroleum for 10 sec. Treated by the first method (*a*) the mango remained in good condition for 42 days when stored at 12·8° and 90% R.H. while the untreated mango rotted in 14 days; all mangoes used were at the same stage of maturity. E. M. J.

Utilisation of tamarind pulp. Y. S. Lewis, C. T. Dwarkanath, and D. S. Johar (*J. sci. industr. Res. India*, 1954, **13, A**, 284—286).—The possibilities of economically utilising the acid fruit of the tamarind tree, *Tamarindus indica* Linn, are discussed. In an integrated industry about 2·5% pectin, 12% tartaric acid, and 12% alcohol should be recoverable. G. C. JONES.

Bitter principles of the Cucurbitaceæ. I. Chemistry of cucurbitacin A. P. R. Enslin (*J. Sci. Food Agric.*, 1954, **5**, 410—416).—Bitter principles were isolated as solid foams from the fruits of several members of the Cucurbitaceæ, and four of these were obtained cryst.: (i) cucurbitacin A, $C_{28}H_{40}O_8$ (**I**) (m.p. 207—208°, $[\alpha]_D^{27}$ + 97·3° in 96% ethanol), from *Cucumis myriocarpus* and *C. leptodermis* in 0·06% yield of the fresh fruit, had a M.L.D. for rabbits of 0·7 mg. per kg. of body wt. by intravenous injection; (ii) cucurbitacin B from *C. africanus* and *Lagenaria leucantha* had a M.L.D. of 0·5 mg. per kg. of body wt.; (iii) cucurbitacin C (m.p. 207—207·5°, $[\alpha]_D^{27}$ + 95·2° in 96% ethanol) in 0·03% yield from a bitter variety of *C. sativus*; and (iv) cucurbitacin D (m.p. 151—152°) in 0·005% yield from a bitter ornamental gourd (variety of *C. pepo*). No cryst. material was obtained from bitter foams of two varieties of *Citrullus vulgaris*. **I** is neutral, containing one Ac group and yields an orange-yellow cryst. mono-2 : 4-dinitrophenylhydrazone, m.p. 228·5° (decomp.); catalytic reduction gives dihydro-**I**, $C_{28}H_{42}O_8$,

m.p. 139—141° [dioxime, m.p. 228·5° (decomp.)]. On prolonged treatment with alkali, reactions other than simple hydrolysis occur. I.r. and u.v. absorption spectra studies of **I** and dihydro-**I** are reported, and general possibilities for its structure are suggested. S. C. JOLLY.

Hygroscopic equilibria of dry beans. W. J. Weston and H. J. Morris (*Food Technol.*, 1954, **8**, 353—355).—Data are reported for seven varieties of beans stored at 25° in R.H. range 11—75%. E. M. J.

Nutritional survey on available food materials. V. Lysine, threonine, phenylalanine contents of pulses. G. C. Esh and J. M. Som (*J. Inst. Chem., India*, 1954, **26**, 147—152).—A wide variation exists in the amino-acid contents of the seven pulses tested; data are given. In comparison of the methods of hydrolysis, lower results were obtained for threonine by enzymic than by acid hydrolysis and higher results were obtained for phenylalanine by alkali than by acid hydrolysis. (12 references.) E. M. J.

Trypsin inhibitors in Indian foodstuffs : I. Inhibitors in vegetables. K. Sohonie and A. P. Bhandarkar (*J. sci. industr. Res. India*, 1954, **13, B**, 500—503).—Trypsin inhibitors were found in 11 out of 65 vegetables tested. In leguminous vegetables the inhibitor was found only in mature seeds, and in turnips it occurred only in certain months of the year. The properties of the inhibitors varied; most of them are precipitated by alcohol, but acetone is a better precipitant; all are non-dialysable, some are precipitated at half saturation of $(NH_4)_2SO_4$, one (from field bean) at 3/4 saturation, and two (cowpea and red gram) at full saturation; some are destroyed by heating at 100° for 1 hr., whereas some are stable at this temp.; autoclaving destroyed most of the inhibitors except that from double bean. E. M. J.

Conservation by cold of foodstuffs of vegetable origin. R. Ulrich (*C. R. Acad. Agric. Fr.*, 1954, **40**, 474).—This book reviewed by R. Combes discusses the constitution of vegetables, and the effects of low temp. on their tissues and their vital functions; the optimum conditions of refrigeration of vegetable products, particular conditions of fresh fruits, whole plants or manufactured products, and finally the effect of rapid freezing of such products. The book is illustrated with figures and diagrams, has a good bibliography and is of interest to all concerned with low temp. work, in food preservation. E. M. J.

Experiences with naturally cloudy, cold stored fruit juices, using the Böhi procedure. H. J. Hartmann (*Schweiz. Z. Obst- u. Weinb.*, 1954, **63**, 72—74).—Cloudy apple juice was stored at 0—1° with 6—8 g. of CO_2 per l. in low-pressure tanks. Excellent results were achieved; this method of storing juice is recommended because it yields better quality products, involves lower production costs, and permits better distribution of labour in the clearing and blending of the juice. FOOD SCI. ABSTR. (R. B. C.).

Behaviour of vitaminised fruit juices during storage. S. Hesse (*Industr. Obst- u. Gemüseverw.*, 1954, **39**, 32—37).—Ascorbic acid was added to apple, pear, and grape juices, and also to tomato marc, and all the products were stored at 7°. The effect of clarification and de-aëration on the content of ascorbic acid in the juices was investigated. In general, the products were improved by addition of ascorbic acid, especially during milling of the raw materials. Up to 40% of the ascorbic acid originally added to the juices (30 mg./100 ml.) was lost during storage for six months. The losses were variable, however, and seemed to depend on the variety of fruit. The clarification of apple juice had a deleterious effect; de-aëration produced a loss of aroma. There was no relation between the air content of the juices and the decrease in ascorbic acid content. When 30, 50, or 70 mg./100 ml. of ascorbic acid were added to grape juice, the loss was greatest with addition of 30 mg. and least with 70 mg. FOOD SCI. ABSTR. (R. B. C.).

Microwave irradiation of orange juice concentrate for enzyme inactivation. D. A. Copson (*Food Technol.*, 1954, **8**, 397—399).—Pectin-methylesterase in orange juice concentrate was inactivated in a counter-flow system for exposing the concentrate to the effect of microwave energy. Diagrams of apparatus, designed for rapid heating of the product and subsequent rapid cooling, and data, including cost on an industrial scale, are given. E. M. J.

Factors affecting the quality and stability of concentrated fruit juices. I. Blackcurrant and apple concentrates. M. E. Kieser, A. Pollard, C. F. Timberlake, and M. R. Mosely (*A.R. agric. hort. Res. Sta. Bristol*, 1953, 189—198).—Increases in ascorbic acid and titratable acidity with sp. gr. during concentration of blackcurrant juice were similar with all methods used (climbing film evaporation at 41—48°, "Coolcentration" at 18—20°, and concentration by freezing). All concentrates had a high flavour quality although the best were those which retained volatile constituents. The colour, flavour, and ascorbic acid content of concentrates deteriorated at storage temp. greater than 0°, although this deterioration was reduced by addition of SO_2. Apple concentrates deteriorated less during storage at 0° than did blackcurrant concentrates. Addition of SO_2 reduced darkening and development of off-flavours during storage at higher temp. A. H. CORNFIELD.

Quality control for confections and jams. J. Graff (*Industr. Obst- u. Gemüseverw.*, 1954, **39**, 58—59).—In Germany, quality evaluation is based on 20 points, which include weight, colour, consistency, external appearance, transparency, aroma, flavour, refractometric value, extract or soluble solids, insoluble material, total solids, water content, total acidity (as citric acid or malic acid), total sugar (as sucrose or as invert sugar), liquid glucose, polarisation after inversion, microscopic findings, and artificial colouring matter; in addition, careful organoleptic examination is carried out by a panel of experts. The points system used is given. FOOD SCI. ABSTR. (R. B. C.).

Pectin content of figs. G. Schade (*Z. LebensmittUntersuch.*, 1954, **99**, 264—267).—Two usual commercial varieties were tested. There was a considerable difference in the pectin content extracted under similar conditions although the uronic acid content of both varieties was initially of similar quantity. This finding is a distinguishing stage in the enzymic de-esterification of the pectins in the figs studied. E. M. J.

Pectin. Evidence of molecular constitution from dry-grinding experiments. L. H. Lampitt, R. W. Money, and B. E. Judge (*Chem. & Ind.*, 1954, 1113).—Previous dry-grinding tests on pectin in a ball mill for 1000 hr. (cf. *J. Soc. chem. Ind., Lond.*, 1947, **66**, 157) have been supplemented by further dry-grinding tests on a purified citrus pectin (Ca pectate 102·1% of total solids) in a ball mill for 8000 hr. Results confirm the comparatively short basic chain length (~6—10 uronic units) of pectin and that these are combined by H bonding (or similar linkages breakable by grinding) to give the large mol. complexes indicated from η measurements, but leaving the reducing end-groups free to react. During grinding the degree of methoxylation decreased by ~50% with a corresponding increase in free acidity value. L. F. TAYLOR.

Carbohydrates for the fermentation industries. II. Use of glucose oxidase in the determination of glucose in fermentation media. M. Damodaran and Kartar Singh (*J. industr. sci. Res. India*, 1954, **13, B**, 419—421).—A simple method is described for the routine determination of glucose in mixtures of sugars by the use of glucose oxidase. An acetone dry powder of the mycelia of *Penicillium chrysogenum* serves as the source of enzyme, and the vol. of O_2 taken up by the glucose is measured in a Warburg apparatus. Other sugars present in fermentation liquors do not interfere. G. C. JONES.

Carbohydrates for fermentation industries. III. Chemical examination and saccharification of sugar cane bagasse. M. Damodaran and R. S. Dhavalikar (*J. sci. industr. Res. India*, 1954, **13, B**, 556—560).—Samples of Indian sugar cane have been examined with special reference to the constituent sugars, their extraction, identification, and determination, and the preparation of crystalline dextrose from the bagasse hydrolysate. It is concluded that bagasse saccharification is comparable with wood hydrolysis as regards the production of alcohol (from the glucose present), of food yeast (from glucose and the pentoses), and of crystalline glucose. G. C. JONES.

Determination on lactic acid [in urine] by oxidation with ceric sulphate. J. F. Cesas Lucas (*An. real Soc. esp. Fis. Quím*, 1954, **50B**, 535—538).—Optimum condition for the oxidation of lactic acid by means of acid ceric sulphate (to acetaldehyde, which is estimated by a bisulphite method) have been worked out. L. A. O'NEILL.

Effect on alcoholic fermentation of new pesticides used in viticulture. J. Roubert (*C. R. Acad. Agric. Fr.*, 1954, **40**, 486—487).—Captan (especially when incorporated with bentonite) added to the must in concn. of 5 mg. of active material per l., causes an initial temporary set-back in the fermentation, without affecting the subsequent course of fermentation or the flavour of the wine; at concn. of 50 or 100 mg. per l., of active material, fermentation is completely inhibited; on removal of the coarse lees, however, a sluggish fermentation sets in, accompanied by undue development of *Mycoderma vini* and *M. aceti*, giving a sharply flavoured wine. Commercially pure Zineb, Parathion, Aldrin, or Dieldrin added to the must in all the above concn. have no effect on the course of fermentation or the flavour of the wine, but the mineral oils and the quaternary NH_4 compounds used in prep. based on Aldrin and Dieldrin, respectively give rise to objectionable flavours in the wine. Spraying with Parathion may reduce the wild yeast population by destruction of the insect vectors of the yeasts. P. S. ARUP.

Composition of the juices of some varieties of cider apples. L. F. Burroughs and Y. P. May (*A.R. agric. hort. Res. Sta. Bristol*, 1953, 178—183).—The sp. gr., titratable acidity, % tannin, rate of fermentation, and % N of the juice of 14 varieties of cider apple are reported.

Over 33 years the average sp. gr. of the juice of Kingston Black was directly related to the no. of hr. of sunshine during June-Sept. Other juice characteristics were independent of weather. The variability of composition of 308 samples of Kingston Black juice are examined statistically. A. H. CORNFIELD.

Rôle of nitrogen and vitamin B_1 in cider-making. L. F. Burroughs and A. Pollard (*A. R. agric. hort. Res. Sta. Bristol*, 1953, 184—188).—A general account of the influence of N and vitamin B_1 (thiamine) on yeast growth in cider. Practical recommendations for the control of cider fermentations are presented. A. H. CORNFIELD.

Microbiological control in cider-making. F. W. Beech and A. Pollard (*A. R. agric. hort. Res. Sta. Bristol*, 1953, 171—177).—An outline of various methods of biological control applicable at various stages of cider-making. A. H. CORNFIELD.

Taste and composition of calvados and cider brandy. J. Lenoir, J. Jacquet, and P. Bonafons (*C. R. Acad. Agric. Fr.*, 1954, **40**, 475—478; cf. J.S.F.A. Abstr., 1954, ii, 240).—An analysis was made of 17 samples each characteristic of the typical taste of the region of origin. The detailed results of these analyses are tabulated. The figures for ethers and alcohols of higher mol. wt. presented a certain regularity, and a mean relation of ethers/alcohol of higher mol. wt. of 1·5. On 250 other samples, of all origins, the Commission of Tasters generally accepted products in which the ethers–alcohols of higher mol. wt. remained fixed within these limits. There were about 30% of exceptions however. The conditions of production and testing are discussed. A systematic taste test by competent persons, in the six months following the making of the products, could ensure a better regularisation of the market for calvados and cider brandy by quality selection. E. M. J.

Determination of furfural, pentoses, and pentosans in distilled spirits. Alex. P. Mathers and John E. Beck (*J. Ass. off. agric. Chem., Wash.*, 1954, **37**, 861—869).—A flask (with reflux condenser) holding the solvent for maintaining a constant temperature contains the reaction chamber fitted with a condenser and a steam inlet tube attached to a steam generator. Boiling xylene affords the max. temperature that should be employed. Furfural is determined spectrophotometrically, although other substances may also absorb light at 277 mμ. For the decomposition of pentosans and pentose HCl or a mixture of HCl and diethylamine is preferred. It is tentatively assumed that 81% of pentose is converted into furfural. A. A. ELDRIDGE.

Ester determinations in distilled liquors with increasing alkali concentrations. Robert L. Schoeneman (*J. Ass. off. agric. Chem., Wash.*, 1954, **37**, 921—922).—An excess of alkali for hydrolysis (*Methods of Analysis*, A.O.A.C., 1950, 9,17) of 5—10 ml. of 0·1N-NaOH results in variations of ester content no greater than 2·6 g. per 100 litres. Less than 4 ml. excess results in variations up to 11·0 g. per 100 litres. A. A. ELDRIDGE.

Speculation on DPN (diphosphopyridine nucleotide) as a biochemical precursor of caffeine and trigonelline in coffee. R. E. Kremers (*J. Amer. pharm. Ass.*, 1954, **43**, 423—424).—More reliable figures for the amounts of these bases are now available and show that roughly equal molecular fractions of caffeine and trigonelline occur in mild coffees, and the possible production of these from DPN is outlined. J. CALEY.

Lysine destruction in casein-glucose interaction measured by quantitative paper chromatography. A. R. Patton, R. C. Salander, and M. Piano (*Food Res.*, 1954, **19**, 444—450.—Under the conditions tested, the greatest loss of lysine occurred from autoclaving with moist heat. During four hours of autoclaving only minor destruction occurred in the relative absence of moisture, or in the presence of an abundance of moisture. Without glucose no significant destruction occurred. By this method differences in % lysine of ~0·36 were significant at the 0·01 level. E. M. J.

Simple chromatographic method for the determination of lactose in milk. A. Nagabhushanam and K. V. Giri (*Curr. Sci.*, 1954, **23**, 221—223).—The procedure described involves (i) spotting an accurate amount (20 μl.) of dil. milk (10 g. diluted to 100 ml.) on a Whatman No. 1 filter paper and known amounts of standard lactose solution on either side of the milk spot, (ii) after the spots have dried, development of the paper with a 20 : 70 : 10 solvent mixture of *n*-butanol–acetone–water, (iii) drying and treating with triphenyltetrazolium chloride (cf. Giri and Nigam, *Naturwissenschaften*, 1953, **40**, 343; *J. Indian Inst. Sci.*, 1954, **35**, 49), and (iv) cutting of the red bands of lactose, colour extraction with 95% alcohol and estimation in a Klett Summerson photoelectric colorimeter. L. F. TAYLOR.

Ion-selective membranes. I. Electrolytic deionisation of protein-free whey. W. H. Wingerd and R. J. Block (*J. Dairy Sci.*, 1954, **37**, 932—937).—Ionisable components of deproteinised whey can be removed easily and quickly by electrodialysis through ion-selective membranes without appreciable loss of diffusible non-ionic substances. S. C. JOLLY.

Dilution and reseparation of cream. T. E. H. Downes (*Fmg S. Afr.*, 1954, **29**, 219—220).—This practice is not recommended. E. G. BRICKELL.

Loss of fat during souring of cream. Jesse E. Roe, Howard Edelson, and William E. Polzen (*J. Ass. off. agric. Chem., Wash.*, 1954, **37**, 849—856).—Loss of fat arising from the souring of cream cannot be detected by the Babcock method over a four-day period. The loss, as indicated by the Röse–Gottlieb method, is about 0·1% of the total percentage of fat per day over a seven-day period. A. A. ELDRIDGE.

Influence of lipins on self-dispersion and on ease of dispersion of milk powder. W. K. Stone, T. F. Conley, and J. M. McIntire (*Food Technol.*, 1954, **8**, 367—371).—The melting range of milk fat is 82·5—96·8°F. Tempering dry whole milk to temp. which cause melting of milk fat increased self-dispersion in water. Slow cooling of dry whole milk from 120°F. to 76°F. acted to decrease self-dispersion. Temp. of water near the melting range of milk fat caused a large increase in the self-dispersion of whole milk powder. As the milk fat content of milk powder was increased, self-dispersion decreased. In water at 75°F., whole milk powder tempered to 120°F. dispersed more rapidly by manual stirring than powder tempered to 72°F. E. M. J.

Ice-cream—its compostiion, analysis, and tentative standards. S. N. Mitra and S. C. Roy (*J. Inst. Chem., India*, 1954, **26**, 159—171).—The fat content of a sample is determined by the Röse–Gottlieb method and a Reichert–Meissl estimation is made. The ratio lactose/proteins is >1·0 in pure milk products. The presence of egg decreases this ratio below 1·0. The milk solids-not-fat should be proportional to the lactose content. A suitable definition of ice-cream and standards for fat, lactose, and milk solids-not-fat are suggested. E. M. J.

Biochemistry of cheese ripening. VII. Phosphorus balance in ripening sour milk cheese. J. Schmuller and H. Huth (*Z. Lebensmitt-Untersuch.*, 1954, **99**, 280—299).—A series of P determinations was made at various stages of the process and a constant ratio of P : N of 1 : 34 was observed in the cheese mass. The average P content of skim-milk cheese was 0·94% (on dry substance), higher than that of pure casein, 0·79%. In the ripening process a considerable quantity of P and N fractions becomes soluble in trichloroacetic acid and the ratio of P : N in such an extract was determined at 0·06. Inorg. phosphates are set free during the ripening. In trichloroacetic acid solution the org. P compounds are stable; they supply an approximate measure of the ripening condition, are stable to acids, but not to alkalis, and are essentially formed from phosphopeptones. By treating cheese with $CCl_3.CO_2H$, pure protein is obtained, showing in all ripening stages a constant P : N ratio of an average 1 : 43 corresponding somewhat with that of pure casein. Out of the cheese mass an alkali-labile phosphopeptone was isolated containing 4·32% of P and 11·06% of N; by fractional pptn. a constant P : N ratio of 1 : 5·6 was found. E. M. J.

Detection of washed eggs by conductivity measurements. II. Field testing. R. R. Hixon and G. F. Stewart (*Food Technol.*, 1954, **8**, 422—424).—Data are presented on conductivity tests applied to washed and unwashed samples of eggs from 20 ranches in California. E. M. J.

Determination of the solubility index of spray-dried eggs. S. J. Bishov and J. H. Mitchell, jun. (*Food Res.*, 1954, **19**, 367—372).—The method involves four main steps: (*a*) dispersion of egg solids in 0·9% saline solution, (*b*) centrifugation of saline-insoluble solids, (*c*) pptn. of saline-soluble and colloidal fraction with Esbach reagent, (*d*) centrifugation of Esbach-pptd. solids and reading the volume of the ppt. in ml. to the nearest tenth, as solubility index. E. M. J.

Fluorescence of liquid egg. I. Relation between the fluorescence and mustiness of frozen whole egg. J. Brooks. **II. Effect of specific bacteria.** J. Brooks and H. P. Hale (*Food Technol.*, 1954, **8**, 400—405, 406—409).—I. The intensity of fluorescence of a clear serum extracted from normal and musty samples of commercial frozen whole egg depended on the pH of the serum, and was least at ~ pH 7·5. In normal samples the fluorescence was quenched by $Na_2S_2O_4$, but was increased by the addition of $Na_2S_2O_4$ to the serum from musty egg. The increase was related to the intensity of mustiness. Freezing and thawing of liquid whole egg decreased the fluorescence; the change was prevented when whole egg contained 1% of trisodium citrate. On dilution of the serum the fluorescence was related to an exponential function of the extent of dilution. (31 references.)

II. Suspensions of *Pseudomonas putida* and an unidentified species of *Pseudomonas* isolated from a musty, cold-stored egg, were injected into shell eggs. The contents of the eggs became musty at an increasing rate. The intensity of mustiness was related quantitatively to a change in the fluorescent properties. The effects of *Aerobacter cloacæ* on the egg-contents are discussed. (7 references.) E. M. J.

Heat resistance of strains of *Salmonella* in liquid whole egg, egg yolk, and egg white. W. W. Osborne, R. P. Straka, and H. Lineweaver (*Food Res.*, 1954, **19**, 451—463).—The heat resistance of 18 strains is described; representative strains of several species were used. Heat resistance varied with strain rather than with species or group, and is greater near pH 5·5 than above pH 7. The heat-resistant strain *S. senftenberg* 775W, is an important stumbling block in the path of successful egg pasteurisation. (31 references.) E. M. J.

Heat resistance in liquid eggs of some strains of the genus *Salmonella*. A. Anellis, J. Lubas, M. M. Rayman (*Food Res.*, 1954, **19**, 377—395).—The pH of liquid egg is an important factor in the heat resistance of *Salmonella*. The F_{140} and D_{140} values (heat resistance of an organism at a given temp. and the logarithmic rate of death, respectively) change as a continuous function with pH in the range between pH 6·1 and 8·5. Most of the *Salmonella* organisms (representing seven serotypes) tested had F_{140} values ranging from 7—9 min. at pH 5·5 and F_{140} values of 2·0—3·5 min. at pH 8·0. *S. senftenberg*, Strain 775W was the most resistant of the *Salmonella* studied, its F_{140} value being 11 min. at pH 8·0. (51 references.) E. M. J.

Comparisons of the quality and stability of whole egg powders desugared by the yeast and enzyme methods. L. Kline, T. T. Sonoda, and H. L. Hanson (*Food Technol.*, 1954, **8**, 343—349).—Glucose oxidase in desugarising whole egg liquid leaves a residue of 5—6% of the original fermentable reducing sugar consisting chiefly of lactose and galactose. This amount does not significantly impair stability. There were slight differences from standard or yeast-desugared powders, such as graininess in scrambled egg, and slightly lower sponge cake volumes. The differences resulted from pH changes. Stability comparisons of glucose-free powders prepared by the two desugarising methods indicated that equivalent stabilisation was achieved as appraised by chemical, functional, and flavour tests. Associated with the yeast process an occasional development of mustiness occurred on storage. (20 references.) E. M. J.

Effect of ageing and cooking on the distribution of certain amino-acids and nitrogen in beef muscle. I. D. Ginger, J. P. Wachter, D. M. Doty, B. S. Schweigert, F. J. Beard, J. C. Pierce, and O. G. Hankins (*Food Res.*, 1954, **19**, 410—416).—Ageing increased the free amino-acid N of raw rib steaks. Cooking caused a very marked decrease in the amount of soluble protein N present and resulted in the liberation of some free amino-N. Only a very small proportion of the total N present in the raw meat was found in the drippings after boiling. This was non-protein-N (NPN), mainly present as free amino-N. A greater % of arginine, leucine, and tyrosine was found in the drippings and NPN fractions after two weeks' ageing than in the paired steaks that were not aged. These and other findings are discussed. E. M. J.

Histological and histochemical study of beef dehydration. III. Influence of pre-cooking. E. Auerbach, H. Wang, V. Bates, D. M. Doty, and H. R. Kraybill (*Food Res.*, 1954, **19**, 429—432).—Samples of *Biceps femoris* were pre-cooked in beef tallow at three different internal temp., 60°, 76·6°, and 93·3°, and dehydrated at two different temp. 16 hr. at 45° in vac., and at 70° in an air oven. The samples were divided into two groups: electrolysed and non-electrolysed. Data indicate that the best internal temp. of pre-cooking was 76·6° for only the electrolysed, block cylinder group (samples ½ in. in diameter, 2 in. in length). Electrolysed block cylinder samples dehydrated at 70°, rehydrated to a higher level of rehydration than those similarly treated samples dehydrated at 45°, regardless of cooking temp. Statistical analysis of the samples indicated a calculated correlation coeff. of 0·612 for moisture content–fibre diameter values. In dehydrating unground beef tissue, there is no marked advantage of pre-cooked over raw meat. E. M. J.

Variation in determination of sheer force by means of the "Bratzler-Warner Shear." H. Hurwicz and R. G. Tischer (*Food Technol.*, 1954, **8**, 391—393).—The max. shear force used as the criterion of tenderness had a pooled coefficient of variation (C.V.) = 7·41%. The best criterion was the slope of the shear force *vs.* time curve; the smallest pooled C.V. = 4·79%. Data on three criteria of tenderness are presented. E. M. J.

The diethylstilbœstrol content of tissues of treated steers, lambs, and poultry. C. E. Swift (*Food Res.*, 1954, **19**, 402—409).—The synthetic œstrogen was determined in fatty, liver, and muscle tissues of steers, lambs, and cockerels which had been treated. In tissues of lambs and a steer no evidence was found, but in the extract of the liver and skin of a cockerel the diethylstilbœstrol content was about 0·25% of the amount implanted. E. M. J.

Appearance of a red coloration during sterilisation of meat. H. Schmidt (*Fleischwirtschaft*, 1954, **6**, 13—14).—The red colour which may develop in meat juice during sterilisation is believed to be due to oxyhæmoglobin from blood which escapes heating above 63° to 65°; such blood is probably derived from bone marrow, and is thus protected from the action of heat. Food Sci. Abstr. (R. B. C.).

Quality of sausages for scalding and determination of water binding in meat. R. Grau and R. Hamm (*Fleischwirtschaft*, 1954, **6**, 36—40).—A simple method for the practical evaluation of the water-binding capacity of meat to be used for preparation of sausages for scalding is based on pressing a known weight of meat on to filter paper and determining the area covered by the pressed meat by means of a Plexiglass ring-foil. The higher the water-binding capacity, the larger is the meat surface. Results obtained by the method are illustrated. Food Sci. Abstr. (R. B. C.).

Methods of objective evaluation of meat. E. Heim (*Fleischwirtschaft*, 1954, **6**, 74—77).—A critical review is made of work on the evaluation of quality in meat, and of the individual factors which constitute quality, *e.g.*, the amounts of connective and muscular tissue, the water content and the water-binding capacity, the contents of total solids and of intramuscular fat, colour of the meat, and protein decomposition. The studies so far carried out form the basis for future work, but no solution of the meat quality problem has yet been found. Attention is drawn to the importance of hormones in relation to quality. Food Sci. Abstr. (R. B. C.).

Water content of fatty tissue in slaughtered pigs and cattle. H. Keller (*Fleischwirtschaft*, 1954, **6**, 77—78).—The water content of the fatty tissues of animals at slaughter is important in connexion with the processing of meat. Highest, lowest, and average values for water content of the fatty tissues of pigs, heifers, cows, and bulls are tabulated. Food Sci. Abstr. (R. B. C.).

Use of the 2-thiobarbituric acid [TBA] reagent to measure randicity in frozen pork. E. W. Turner, W. D. Paynter, J. E. Montie, M. W. Bessert, G. M. Struck, and F. C. Olson (*Food Technol.*, 1954, **8**, 326—330).—A reliable index of the age and quality of frozen pork for fat rancidity is obtained. A significant positive correlation was found between taste test acceptability scores and the TBA value of pork used. The method may be used for grading the quality of meat to be used in the manufacture of sausage products. (16 references.) E. M. J.

Chemical test for estimating oily and fishy off-flavour in bacon. E. Eskö e and J. Madsen (*Acta agric. scand.*, 1954, **4**, 266—271).—The method is based on the measurement of a red colour developed by thiobarbituric acid. Influence of pH, acid concn., and time upon the results is discussed and tabular data are presented of the correlation between colour index and flavour. E. G. Brickell.

Influence of temperature and cooking salt on the bacilli of the mesentericus-subtilis group and its relation to the origin of the acridity and putrefaction of core in types of raw sausage. F. Schönberg and E. Walz (*Fleischwirtschaft*, 1954, **6**, 33—35).—The effects of various temp. (between 12° and 37°) and salt contents (between 3 and 15%) on the growth of bacteria of the mesentericus-subtilis group were examined. Bacterial counts indicated that, at optimal temp., bacterial growth is not appreciably retarded by a salt content of 3%. It is concluded that raw sausages should be dried and smoked at temp. $\gtrsim$18°. Any further rise in temp. during processing may cause deterioration in quality of the sausages, owing to the development of acrid and sour flavours. Food Sci. Abstr. (R. B. C.).

Thermal death time/temperature relationships of *Salmonella typhimurium* in chicken muscle. D. L. Husseman and J. K. Buyske (*Food Res.*, 1954, **19**, 351—356).—Samples of chicken muscle inoculated with large no. of *S. typhimurium*, Strain 84, were heated in an oil bath at temp. corresponding to those of cookery operations. These micro-organisms appeared to survive higher temp. than have been observed for destruction in other products. The data appear to indicate that cookery may not free poultry of certain organisms of the Salmonella type. (14 references.) E. M. J.

Resistance of bacterial spores to γ-irradiation. B. H. Morgan and J. M. Reed (*Food Res.*, 1954, **19**, 357).—The spores of *Clostridium botulinum* were more resistant to γ-radiation than spores of the other food spoilage organisms studied, but different conditions during spore production or irradiation can increase or decrease the sterilisation requirement for a particular type of organism. E. M. J.

Simplified procedure for extraction and determination of vitamin A in liver. S. R. Ames, H. A. Risley, and Phillip L. Harris (*Analyt. Chem.*, 1954, **26**, 1378—1381).—The liver is dried by grinding with anhyd. Na_2SO_4, ethyl ether is added, and the vitamin A is extracted into it by shaking. The vitamin A content of an aliquot is determined by the standard Carr–Price reaction ($SbCl_3$), the resulting blue colour being measured at 620 mμ. The recovery of vitamin A at three levels, 30, 150, and 300 μg. averaged 98·6 ± 0·56%, and there is no indication of extraction of materials from the liver which interfere with the determination. The standard deviation of a single result is ± 2·4%. The method compared well with the best of four other procedures tried. G. P. Cook.

Constitution of gelatin. Separation and estimation of peptides in partial hydrolysates. W. A. Schroeder, L. M. Kay, J. LeGette, L. Honnen and F. Charlotte Green (*J. Amer. chem. Soc.*, 1954, **76**, 3556—3564).—Thirty-four peptides from partial acidic and basic hydrolysates of gelatin are separated chromatographically, identified, and quant. estimated. The results throw some further light upon the peptide sequence in gelatin and collagen. A. Jobling.

Some factors affecting the sodium chloride content of haddock during brine freezing and water thawing. J. Holston and S. R. Pottinger (*Food Technol.*, 1954, **8**, 409—414).—This study was made of the commercial feasibility of freezing fish at sea. Penetration of salt was influenced by temp., concn., and composition of the sodium chloride brine, by length of time the fish were immersed in the brine, and whether the fish were gutted or ungutted. Under normal routine operating conditions the excessive penetration of salt did not occur, and after water thawing of the fish the salt content is reduced to a level which is usually below the taste threshold (0·5%) for salt in fish. (13 references.) E. M. J.

Urea content and ammonia formation of the muscle of cartilaginous fishes. II. III. M. Suyama and T. Tokuhiro (*Bull. Jap. Soc. sci. Fish.*, 1954, **19**, 935—938, 1003—1006).—II. The muscles of freshly caught Elasmobranch fishes contain 1·7—2% of urea and 0·006—0·036% of volatile basic nitrogen; in frozen and ice-stored fish on the market, these values are 1—2% and 0·009—0·130% respectively.

III. The concn. of urea in different tissues and organs of Elasmobranch fish is relatively constant if referred to the water content of each part. The concn. of trimethylamine oxide is not constant in relation to water content, and is higher in muscle, heart, and yolk, than in other parts. Food Sci. Abstr. (R. B. C.).

Studies on fish curing. III. Smoking conditions affecting the quantity of deprived formaldehyde. K. Murata and K. Ohoishi (*Bull. Jap. Soc. sci. Fish.*, 1954, **19**, 1015—1020).—Using filter paper as the source of smoke, the concn. of formaldehyde in the smoke was increased by moistening the paper, and by heating it more quickly and to a higher temp. The same tendencies were found with sawdust as the fuel. Food Sci. Abstr. (R. B. C.).

Smoke flavour and ascorbic acid as preservatives for fatty fish. A. M. Erdman, B. M. Watts, and L. C. Ellias (*Food Technol.*, 1954, **8**, 320—323).—Concentrations of 0·5% of a commercial liquid smoke gave good protection against rancidity and bacterial spoilage in refrigerated mackerel and mullet, but gave too strong a smoke flavour; concn. of 0·1% had considerable preservative effect. Ascorbic acid had no effect against rancidity. Concn. of 0·4 and 0·8% of liquid smoke were toxic to cultures of *Staphylococcus aureus*, *Bacillus subtilis*, and *Proteus vulgaris* and concn. of 0·08% decreased growth of these organisms. (14 references.) E. M. J.

Salting procedure for buckling. P. Biegler (*Fischw.- u. Feinkostind.*, 1954, **26**, 41—46).—The following factors should be taken into account: quantity of herring, strength and amount of brine, quant. relation between brine and herring mass, duration of salting, and weather conditions. Larger fish require somewhat more salt than smaller fish; as a rule, Norwegian herring requires 10—12% of brine, German 3—5%, Dutch 8%, Belgian 7%, and Baltic 6%. Addition of ice, or cold weather, prolongs the diffusion of salt into the fish flesh. Concn. of salt above 18% lead to deleterious changes in the skin and cause greying of the heads of the fish; smoking of such herring causes discoloration.

Food Sci. Abstr. (R. B. C.).

Botulinus poisoning from fish. H. Harmsen (*Dtsch. Lebensmitt. Rdsch.*, 1954, **50**, 52—54, 97—100).—Several instances are quoted of poisoning with botulinus toxin due to consumption of fish or fish products. Conditions which favour formation of the toxin are: (*a*) humidity equal to at least 30% of water, (*b*) anaërobic conditions, sometimes localised in the less permeable parts of the food, and (*c*) a temp. of 25—30°, but not 37°, which is too high to permit growth of *Bacillus botulinus*. A 10% concn. of NaCl and pH below 4 are recommended as preventives. Rapid cooling of cans containing fish is essential, also the maintenance of sufficiently high concn. of salt and vinegar after these substances have diffused into the fish flesh during preparation of cooked marinades; each "cooking" should be followed by replacement of the correct amount of salt and vinegar in the liquid. A rancid flavour and odour is characteristic of *B. botulinus*. Food Sci. Abstr. (R. B. C.).

Animal protein factor and vitamin B_{12} in marine products. III. Seaweeds (2) and others. Y. Hashimoto and T. Sato. **IV. Variations in vitamin B_{12} content of marine animals in spoilage.** T. Mori, Y. Hashimoto and Y. Maeda (*Bull. Jap. Soc. sci. Fish.*, 1954, **19**, 987—990, 991—996).—III. Determinations by the Euglena method showed marked variations in the content of vitamin B_{12} in marine algæ, not correlated with classification. Relatively high concn. were found in *Daphnia* and in the diatom *Skeletonema*, in the freshwater unicellular algæ *Microcystis* and *Chlorella*, and in the bottom mud of certain freshwater ponds.

VI. The vitamin B_{12} content of fish allowed to spoil at room temp. decreased more markedly in whole fish than in minced flesh. The decrease was due to the action of bacteria, and did not occur in fish treated with toluene or held at − 2° to − 5°.

Food Sci. Abstr. (R. B. C.).

Expression of oil from dried fish meal. H. Einarsson, R. O. Sinnhuber, and O. J. Worthington (*J. Agric. Food Chem.*, 1954, **2**, 946—950).—A process is described for removing oil from fatty fish meal which avoids the loss of nutrients that occurs in the wet-reduction process and saves the cost of evaporation. The meal is dried to 5—9% moisture and the oil expressed by hydraulic pressure until ≯6% remains in the meal. The expressed oil has a lower free fatty acid content than has the residual oil in the cake. The efficiency of oil removal depends on temp., dwell time, pressure (providing the piston is large enough to minimise wall effects), age of dried meal, original oil content, and final moisture content. Empirical equations allowing prediction of press efficiency in removing oil are given. S. C. Jolly.

Rheology of fats. G. W. Scott Blair (*J, Sci. Food Agric.*, 1954, **5**, 401—405).—A review with 40 references. S. C. Jolly.

Component fatty acids of marine fish liver oils. S. P. Pathak and P. N. Suwal (*J. Amer. Oil. Chem. Soc.*, 1954, **31**, 332—334).—The fatty acid contents of the liver oils of the Elasmobranchs, *Carcharias melanopterus* and *Pristis cuspidatus* are reported. The *Carcharias melanopterus* liver oil fatty acids consist of 31·1% saturated acids (myristic 3·1, palmitic 18·4, stearic 9·5, and arachidic 0·1%) and 68·9% unsaturated acids (C_{16} 10·8, C_{18} 19·7, C_{20} 15·2, C_{22} 17·1, and C_{24} 5·3%), whilst the values for *Pristis cuspidatus* are 36·9% saturated acids (in the order above 1·2, 22·9, 12·7, and 0·1%) and 63·1% unsaturated acids (8·2, 28·5, 16·4, 5·2, and 4·6%). It is suggested that the abnormal content of saturated acids compared with typical marine fat (~20%) is due to biohydrogenation. D. Bailey.

Preventing oxidation of fish oils and fish products. I. Effects of butylhydroxyanisole (BHA) on fish oils. S. Otani, K. Takayanagi, and T. Matsuhashi (*Bull. Jap. Soc. sci. Fish.*, 1954, **19**, 947—951).—Addition of 0·02% of BHA to sardine oil either before or after processing was equally effective in preventing oxidation of the oil (as measured by peroxide number) during storage in various conditions.

Food Sci. Abstr. (R. B. C.).

Use of rice oil of high acidity. I. G. B. Martinenghi (*Chim. e l'Industr.*, 1954, **36**, 264—274).—Methods for the decolorisation, deacidification and refining of, extraction of wax and other substances from, and chemical modification (including hydrogenation) of, rice oil are described. (186 references.) J.A.C. Abstr.

Filtration-extraction: a new process for direct solvent extraction of oily materials. J. J. Spadaro and A. V. Garci, jun. (*Olii min.*, 1954, **31**, 103—107).—A method worked out in the U.S.A. for the direct solvent extraction of oil from crushed oil seeds is described, with flow-sheets, photographs, and some numerical data. The process is cheaper than existing ones, and just as efficient.

J.A.C. Abstr.

Rapid method for determination of oil in oil-seeds. T. François G. Bleicher (*C. R. Acad. Agric. Fr.*, 1954, **40**, 314—316).—The sample (5 g.) of soft seed (which may include soya-beans) is treated for three periods of 3 min. with three successive portions of 30 ml. of light petroleum (b.p. 40—60°) in a micro-mill, in which is mounted a stainless-steel agitator revolving at 15,000—18,000 r.p.m. Under these conditions, all cellular tissue is disintegrated. The miscellæ are (after settling for a short time) successively decanted on to a sintered-glass filter, and the oil is determined gravimetrically in 25 ml. of the mixed filtrate and washings, after these have been made up to 150 ml. Materials such as copra or palm-nuts should be comminuted (dry) in a Turmix-type mill before weighing-out and further treatment. The results thus obtained compare favourably as regards reproducibility, with those obtained by the standard (Soxhlet extraction) method. J.A.C. Abstr.

Recent progress in the detection of adulteration of edible oils and fats. S. N. Mitra (*J. Inst. Chem., India*, 1954, **26**, 138—146).—The analysis of mustard oil, butter-fat (ghee), and hydrogenated fat is discussed. In addition to routine tests, special colour and other tests are described for detecting small amounts, such as the presence of sesame, argemone oils, mineral oil, groundnut and linseed oils, etc. in mustard oil, hydrogenated fat in ghee, and small amounts of butter-fat in the hydrogenated vegetable product *vanaspati*. (27 references.) E. M. J.

Peanut butter. VI. Effect of roasting on the palatability of peanut butter. N. J. Morris and A. F. Freeman. **VIII. Effects of processing and storage on vitamin A incorporated in peanut butter.** R. K. Willich, N. J. Morris, R. T. O'Connor, and A. F. Freeman (*Food Technol.*, 1954, **8**, 377–380, 381—384).—VI. Taste panel data indicate that peanut butters from medium roasted pea[ground]nuts exhibited the most desirable flavour and good flavour retention. (13 references.)

VIII. While no significant losses could be attributed to temp. only, a definite but small loss in vitamin A may be ascribed to the inclusion of atm. O_2 and to frictional heat produced in the manufacture of the product. The content of vitamin A incorporated was satisfactorily high (although reduced) after storage of the butter at either 80 or 100°F. (14 references.) E. M. J.

Stability of added vitamin-A acetate in groundnut oils. B. R. Roy (*J. sci. industr. Res. India*, 1954, **13, B**, 496—499).—The results are presented of an investigation on the stability of vitamin-A acetate in crude and refined groundnut oils and in blended and straight-hardened hydrogenated groundnut oils. Samples were stored in cans at 37·5° and 60° after which the vitamin A content was measured by u.v. absorption. The straight-hardened hydrogenated groundnut oil retained the maximum amount of the vitamin at both temp. and the refined oil the least. The vitamin-A acetate is partially protected by ethyl gallate. G. C. JONES.

Chromatographic-spectrophotometric method for determination of vitamin A in margarine. Lawrence Rosner and Henrietta Kan (*J. Ass. off. agric. Chem., Wash.*, 1954, **37**, 887—894).—Margarine is saponified and extracted with ether, the residue from the evaporation of the ether being dissolved in light petroleum and passed through a column of alkali-treated alumina. Vitamin A is eluted with ether dissolved in light petroleum, successive portions containing increasing amounts of ether. Solvent is removed from the vitamin A fraction with N_2, the residue is dissolved in *iso*propanol, and the vitamin A determined spectrophotometrically at 325 mμ. A. A. ELDRIDGE.

Chemical aspects of cashewnut [*Anacardium occidentale*] shell liquid. J. Roy (*J. Inst. Chem., India*, 1954, **26**, 172—183).—The constitution of the components of the acrid vesicant oil derived from the hard shell of the nut is reviewed. About 90% of the oil, obtained by solvent extraction, is anacardic acid, the remainder is mainly cardol. The varied uses of shell oil are discussed. (25 references.) E. M. J.

Relationship between the oxidative polymers of soya-bean oil and flavour reversion. S. S. Chang and F. A. Kummerow (*J. Amer. Oil Chem. Soc.*, 1954, **31**, 324—327).—The polymers formed during the autoxidation of soya-bean oil at 60° are isolated by a solvent-extraction method, using ether and pentane–hexane as solvents. The more polar polymer fraction is further oxidised by air at 30° giving carbonyl compounds identical with those previously obtained from reverted soya-bean oil. The same polymer fraction (21·04% O) is degraded to volatile carbonyl compounds under vacuum and also under oxygen-free N_2. It is suggested therefore that these polymers serve as precursors of reversion compounds. D. BAILEY.

Effect of shortening consistency and added antioxidants on the keeping quality of biscuits. M. R. Sahasrabudhe, D. S. Bhatia, and V. Subrahmanyan (*J. sci. industr. Res. India*, 1954, **13, B**, 521—524).—The effect of the m.p. (consistency) of the shortening, and thus of the " free oil " content of the product, on the keeping quality of biscuits (in India), and the " carry through " properties of butylated hydroxyanisole (BHA) alone and in combination with propyl gallate and citric acid, have been studied. Shortening with m.p. 41° was more stable than shortening melting at 37°. The use of BHA alone gave a slight improvement in shelf life; its protective effect was further enhanced when used in combination with propyl gallate and citric acid. G. C. JONES.

Relation of synergist to antioxidant in fats. O. S. Privett and F. W. Quackenbush (*J. Amer. Oil. Chem. Soc.*, 1954, **31**, 321—323).—Citric and ascorbic acids delay substantially the rate of peroxide accumulation, during the induction period, of lard which contains pro-oxidant levels of α-tocopherol or nordihydroguaiaretic acid. While low levels (0·025%) of both acids show effective synergistic action with α-tocopherol, higher levels are proportionately less effective. This is contrary to the assumption that these acids function as reservoirs of H to regenerate the antioxidant. Tocopherol has a marked protective effect on ascorbic and phosphoric acids in autoxidising lard. It is suggested that ascorbic and citric acids function as synergists in natural fats and oils by inhibiting the antioxidant catalysis of peroxide decomposition. This concept is discussed in relation to current theories of the mechanism of synergist action. D. BAILEY.

Determination of fat in canned cream soup. Report of a Committee of the Food Manufacturers' Federation. (*Analyst*, 1954, **79**, 509—510).—A method is recommended for determination of fat in canned cream soup. The sample (5 to 10 g.) is mixed with 2 ml. of ethanol, 10 ml. of dil. HCl (25 + 11) are then added and the mixture is heated in a water bath at 70—80° until the liquid is practically clear. Ethanol (10 ml.) is added to the cooled liquid and the usual ether–light petroleum extraction of fat carried out. The mixed solvent layer is siphoned through a cottonwool filter into a distillation flask. After removal of the solvent the residual fat is dried, dissolved in light petroleum, filtered through paper into a tared flask, the solvent is removed and the fat is dried and its purification repeated until its wt. is constant. A. O. JONES.

Determination of copper in oils and fats by means of dibenzyldithiocarbamic acid and its salts. D. C. Abbott and R. D. A. Polhill (*Analyst*, 1954, **79**, 547—550).—A method is described for the rapid absorptiometric determination of Cu (0·02 to 2 p.p.m.) in oils and fats. The sample (20 g.) is first heated in a silica flask until its vol. is reduced to 1 or 2 ml. and destruction of organic matter is then continued by a wet ash process. The diluted residual liquid is heated with Na_2SO_3 to remove NO_2 and is then extracted with a solution of a colour reagent in CCl_4. The colour reagent may be dibenzyldithiocarbamic acid or its Zn, K, or dibenzylammonium salt. The preparation of these is described. The absorption of the extract is measured at 435 mμ. and the Cu content is ascertained from a calibration graph prepared by the same procedure. Interference by other commonly occurring metals is negligible and recovery is good. A. O. JONES.

Simplified separation of non-saponifiable matter in oils. F. J. Mulder (*Rec. Trav. chim. Pays-Bas*, 1954, **73**, 626—628).—The non-saponifiable matter, *e.g.*, vitamins A and D, is separated by saponification of the oil (0·1—1 g.) in N-(m)ethanolic KOH (10 ml.), followed by complete dissolution of the alcoholic soap solution in a known vol. (~40 ml.) of benzene. The benzene solution is then washed several times with water (~25 ml.), dried over flake $CaCl_2$, filtered, and the concn. of non-saponifiable matter determined spectrophotometrically or colorimetrically. The method, which is applicable to food prep., obviates the usual lengthy extraction and quant. transfer of extracts. W. J. BAKER.

Determination of phenolphthalein in chocolate preparations by non-aqueous titration. S. Doernberg, M. Hubacher, and I. Lysyj (*J. Amer. pharm. Ass.*, 1954, **43**, 418—420).—A simple and convenient method is described based on a closed system which preserves a comparatively non-contaminating atmosphere, and enables about 12 determinations to be made in an 8-hr. day. The fat is extracted from the chocolate with CCl_4, and the phenolphthalein with three portions of acetone. The acetone is evaporated off, and the residue is treated with anhyd. ethylenediamine and pyridine (15 : 85 by vol.) and the mixture titrated electrometrically with Na dissolved in ethanolamine and pyridine (1 : 5). J. CALEY.

The sea and world food supplies. D. B. Finn (*Nutr. Abstr. Rev.*, 1954, **24**, 487—496).—The following items are discussed: the state of world food supplies; supplies of food from fisheries, including consumption of fishery products per head; the prospect for increase in aquatic food, including phytoplankton and seaweeds, zooplankton, marine fish, crustaceans and molluscs, freshwater fish and fish culture. (37 references). E. M. J.

Influence of vitamins on nitrogen metabolism. II. Influence of neopyrithiamine, γ-(3 : 4-ureylene*cyclo*hexyl)butyric acid, and aminopterin on amino-acid changes during germination. V. M. Sivaramakrishnan and P. S. Sarma (*J. sci. industr. Res. India*, 1954, **13, B**, 413—418).—In an attempt to elucidate the rôle of thiamine, biotin, and folic acid in intermediary amino-acid metabolisms during germination, the effects of the corresponding anti-vitamins neopyrithiamine, γ-(3 : 4-ureylene*cyclo*hexyl)butyric acid and aminopterin on amino-acid levels, during germination of green gram (*Phaseolus aureus*) seedlings, either alone or in combination with the vitamin, have been studied. The effects of these substances on the amino-acids developed during germination are described, and probable pathways leading to the formation of aspartic acid and asparagine are suggested. G. C. JONES.

Plate assays of vitamins of the B group. A. Jones (*Analyst*, 1954, **79**, 586).—In previous work (Brit. Abstr., C, 1949, 409; 1951, 55;

1952, 113; **1953, 318**) on plate assays for thiamine, vitamin B_6, inositol, nicotinic acid, pantothenic acid, and biotin in yeasts and yeast products, the use of five plates for the standard and five for each test sample with four or five levels of standard or sample in each plate was recommended. Recently the more normal (2 + 2) assay design had been successfully used. With test material of approx. known vitamin content widely spaced standards can be used, the dose levels being arranged to lie well within the linear portion of the dose response curve. Riboflavin in tablets and yeast extracts has been assayed by a plate method with the basal medium previously reported (Brit. Abstr., C, 1950, 608) for a 17-hr. tube assay. One ml. of a suspension of *Lactobacillus helveticus* with opacity ≡ tube No. 5 of the Wellcome series was used as inoculum for each 20 ml. of basal medium. The levels of reference standard used in these assays are given with indications of the precision.

A. O. JONES.

Microbiological determination of vitamin B_{12} utilising a mutant strain of *Escherichia coli*. F. J. Bandelin and J. V. Tuschhoff (*J. Amer. pharm. Ass.*, 1954, **43**, 474—477).—Employing a simple turbidimetric method for the assay of vitamin B_{12} using a new *E. coli* 113-3 mutant, the results obtained with cyanocobalamin standards and various tissues and extracts compared favourably with those obtained by the *Lactobacillus leichmanii* method. Growth response is affected by shaking during incubation period, tubes not shaken show a steeper growth response curve, reaching a max. in a shorter time period. Methionine interferes if present in concn. of more than 70,000 times that of the vitamin.

G. R. WHALLEY.

Antimolding agents for syrups. C. F. Lord, jun., and W. J. Husa (*J. Amer. pharm. Ass*, 1954, **43**, 438—440).—Using an accelerated test method, more than 200 chemicals, volatile oils, and synthetic flavouring agents were evaluated in regard to their preservative effects. In comparison with benzoic acid which was effective at a concentration of 1 : 1000, cinnamic aldehyde was effective at 1 : 10,000 and oxyquinoline sulphate at 1 : 100,000.

J. CALEY.

Antioxidant activity and antagonism to microbial growth by piperine, *iso*nicotinyl hydrazide and related compounds. T. Hasselstrom, G. P. Dateo, H. S. Levinson, W. H. Stahl, E. J. Hewitt, and K. S. Konigsbacher (*Food Res.*, 1954, **19**, 373—376).—Black pepper spice, pepper oleoresin, piperine, *apo*piperine, β-cinnamylacryloyl hydrazide and *iso*nicotinyl hydrazide allowed no fungal growth at 0·1% concn.; at 0·01% concn. the growth was appreciably retarded. Pepper oleoresin and *apo*piperine are bacteriostatic at the same concn. Pepper oleoresin, β-cinnamylacryloyl hydrazide, 5-phenyl-3-pentoyl hydrazide, and *iso*nicotinyl hydrazide had definite antioxidant activity in concn. of 0·1%. *iso*Nicotinyl hydrazide had an activity ten times higher than that of pepper oleoresin and the tocopherols. The good storage qualities of the spice, resistance to oxidation and microbiological growth are due to its high concn. of tocopherols and oleoresin.

E. M. J.

Mechanism of the Mohler reaction for the estimation of benzoic acid. W. Davey and J. R. Gwilt (*J. appl. Chem., Lond.*, 1954, **4**, 413—148).—By synthesis of a series of dinitrobenzoic acids and examination of the absorption spectra of the reduced solutions, it is shown that only 2 : 5-dinitrobenzoic acid gives a reddish colour typical of the Mohler reaction, which is used for the determination of benzoic acid in fruit juices and cordials. The mechanism of the colour development is studied by treating the dinitrobenzoic acids in a method similar to that of Meisenheimer and Patzig (*Ber. dtsch. chem. Ges.*, 1906, **39**, 2526). Findings are in agreement with the postulate of these authors that the colour development is due to formation of quinonoid structures. (20 references.)

R. J. MAGEE.

Determination of propylene glycol and glycerol in foods and medicinals. Alex P. Mathers and Maynard J. Pro (*J. Ass. off. agric. Chem., Wash.*, 1954, **37**, 869—874).—Propylene glycol is distilled in a controlled-temperature still with Na formate and KOH; glycerol is distilled with mineral oil. A mixture is distilled with mineral oil, and the distillate is collected in two fractions. In all cases Na periodate is used for oxidation, the amount used in the oxidation of propylene glycol being determined by differential titration with Na arsenite after addition of $NaHCO_3$ and KI. Glycerol is determined after oxidation by titration with NaOH. Recoveries of propylene glycol and glycerol, respectively, were 98—101 and 97—101%.

A. A. ELDRIDGE.

Determination of vanillin in vanilla extracts. A. Maurel and [Mme.] S. Lalement (*Chim. anal.*, 1954, **36**, 241—244).—A colorimetric determination by nitrosation, and titrimetric by oximation of vanillin are compared with known gravimetric methods and shown to be superior to the colorimetric method with Folin–Denis reagent, which is affected by impurities present in vanilla extracts. In the nitrosation method, a sample of 1—5 c.c. of extract is diluted with distilled water, pptd. with Pb acetate, and excess Pb removed with 10% H_2SO_4. An aliquot portion of the filtrate is buffered (acetate buffer) to pH 4 and 10% aq. $NaNO_2$ added. The tube is heated for 15 min. on the boiling water-bath, and after cooling and making up to 10 c.c., the absorption at 4150 *a*. of the yellow substance formed (presumably 4-hydroxy-3-methoxy-5-nitrosobenzaldehyde) is measured. Ethylvanillin gives an absorption max. at the same λ, but *iso*eugenol, anisaldehyde, and other phenolic compounds, reacting under these conditions, have absorption max. at different λ. In the oximation method, 0·5—5 c.c. of the extract is diluted with ethanol, adjusted to % pH ≃6 with N-KOH–ethanol and hydroxylamine hydrochloride solution added. The pH is measured immediately after addition of the reagent, and, after 30 min. when the reaction is complete and all the HCl is liberated from the reacted hydrochloride, the solution is titrated with 0·01 N-KOH until the pH is the same as at the moment of adding the reagent. A comparison of results is given with the Folin–Denis and with two gravimetric methods.

E. J. H. BIRCH.

Polyfunctional ketones. M. B. Jacobs (*Amer. Perf.*, 1954, **64**, 135—136).—Physical characteristics and flavouring applications are described of: 2-hydroxy-3-methyl*cyclo*pent-2-en-1-one; maltol, 3-hydroxy-2-methyl-4-pyrone; and α-irone, 4-(2 : 5 : 6 : 6-tetramethyl-2-*cyclo*hexenyl)but-3-en-2-one.

G. HELMS.

Characterisation of essential oils. Mentha genus oils. R. H. Reitsema (*J. Amer. pharm. Ass.*, 1954, **43**, 414—418).—A study of the various mint types is made to gain insight as to the mechanism of their oil formation. They are classified according to chromosome number and the predominant ketone is named. The types are characterised by various physical constants. Typical chromatoplate patterns are given for carvone oils and methone oils.

J. CALEY.

Reliability of taste testing and consumer testing methods. I. Fatigue in taste testing. E. A. Laue, N. H. Ishler, and G. A. Bullman. **II. Code bias in consumer testing.** N. H. Ishler, E. A. Laue, and A. J. Janisch (*Food Technol.*, 1954, **8**, 387—388, 389—391).—I. Fatigue as measured by the presentation to the tasters of two successive sample triangles, was observed in the tasting of maple syrup, but not in coffee tasting; other workers found that fatigue was apparent in the tasting of beer.

II. Bias effect was minimised by selecting code pairs which had been demonstrated to show little bias and by reversing codes between test halves. The code biases are thereby equalised so that they no longer operate in favour of one sample at the expense of the other.

E. M. J.

Metal cans of the future. K. W. Brighton, R. W. Pilcher, and R. H. Lueck (*Food Technol.*, 1954, **8**, 424—430).—Various sheet metals which have possibilities of being used as alternatives to tin plate, and techniques by which containers may be manufactured are discussed.

E. M. J.

Recovery of ion-exchange regenerant. R. H. Cotton, G. O. Rorabaugh, and N. A. Harris. Assrs. to Holly Sugar Corp. (U.S.P. 2,678,288, 20.2.50).—The anion-exchanger, in an ion-exchange plant for treating sugar juices, is regenerated with 2—5% of aq. NH_3. The spent regenerant is passed through a heat-exchanger (the condenser for the subsequent evaporated aq. NH_3) and then into an evaporator where 1·0—1·5% (≯2%) of lime is added and 10—15% (≯22·5%) of liquid is driven off. The lime tends to increase the NH_3 recovery and prevent the formation of scale in the NH_3 condenser. Recovery of NH_3 is ~97—98%. A part of the rinsing water used for the anion-exchanger may be added to the spent regenerant for NH_3 recovery; this rinsing water may comprise water previously used for rinsing the cation-exchanger.

SUG. IND. ABSTR. (E. M. J.).

[Beer and carbonated beverage]—cooling and dispensing system. C. A. Clements (B.P. 707,686, 21.1.52. Can., 20.1.51).—The hand-operated volume dispenser draws beverage from a container in a cold storage space. The dispenser itself is kept cold by drawing in cold air from the refrigerated compartment each time it is operated.

J.A.C. ABSTR.

[Milk–cream] separator. Sharples Corp. (Assees. of Leo D. Jones) (B.P. 711,695, 13.11.50. U.S., 19.11.49).—The design of the centrifugal bowl (operated under "full bowl" conditions) is such that the temp. of the milk can be as low as 40° F. (normally >100° F.) and effective separation can still be achieved.

J. W. MULLIN.

Treating liquids with gases or vapours [*e.g.*, deodorisation of oils, fats, waxes, etc.] Metallgesellschaft A.-G. (B.P. 707,468, 16.8.51. Ger., 18.8.50).—The oil is contained in a treatment vessel under vacuum, and steam is used as the circulating medium. Frothing is prevented by discharging the liquid in the vapour space of the vessel from different superimposed points. Circulation is increased and

the treatment time is reduced. The movement of liquid can be further intensified by incorporating a stirrer. J.A.C. ABSTR.

Container for transporting liquids [*e.g.*, foodstuffs] in bulk. J. Lyons & Co., Ltd. and Percy White (B.P. 708,813, 7.12.50).—A plastic, flexible bag (made, *e.g.*, of *poly*vinyl chloride) with an elongated tubular neck is inserted in a steel drum which has a small central opening in its top lid. The bag is placed in the drum, then filled with liquid and the long neck is heat sealed. The liquid is unloaded by cutting off a small length of the sealed neck and pouring the liquid out. After sterilisation, the plastic inner container can be re-used until its long neck is exhausted. J.A.C. ABSTR.

3.—SANITATION

Preparation of concentrated pyrethrum extract. I. C. Chopra, K. L. Handa, and V. Prabhakar (*J. sci. industr. Res. India*, 1954, **13, A,** 326—327).—Investigations undertaken to evolve a process for the preparation of concentrated extracts of pyrethrum flowers are discussed briefly. The extract is suitable for a variety of insecticides for agricultural, veterinary, and domestic uses. Extracts containing 15—20% of pyrethrins have been obtained using solvent oil (a petroleum fraction), and a cream has been prepared which when applied to the skin affords almost complete protection against mosquito bites for 4—5 hr. G. C. JONES.

Pyrethrum flower toxicants: stability of toxicants as affected by fermenting before drying. M. S. Lowman, W. A. Gersdorff, and N. Mitlin (*Soap, N.Y.*, 1954, **30,** No. 8, 139—145, 159).—Fermenting pyrethrum flowers before drying and storing improves the stability of the toxic constituent; flowers stored in closed containers for 6 days and for 4, 6, or 12 months before drying were, in chemical and biological assays, more potent after 34—58 months' storage than the controls dried at room temp. without previous treatment. G. HELMS.

Protection of stored shelled maize with a protectant dust in Indiana. J. V. Osmun (*J. econ. Ent.*, 1954, **47,** 462—465).—Maize treated with "Pyrenone Protectant T-483" (piperonyl butoxide (1 : 1)–pyrethrins (0·08%)–maize cob flour carrier) was protected for a two-year period from stored grain insects. Untreated bins of maize were infested with insects, the saw-toothed grain beetle being abundant. A. A. MARSDEN.

Cyclethrin. Anon. (*Farm. Chem.*, 1954, **117,** No. 7, 35).—A note on this new insecticide, [3-(2-*cyclo*pentenyl)-2-methyl-4-keto-2-*cyclo*pentenyl chrysanthemumcarboxylate]. Synergists for pyrethrins are even more effective with Cyclethrin. To produce ranges of toxicity similar to that of pyrethrins (with synergist) approx. 1·6—1·8 as much Cyclethrin is needed. Promising results have been obtained in controlling flies (domestic or in cattle stalls or stables). A. G. POLLARD.

Synergists for allethrin against the body louse. G. W. Eddy, M. M. Cole, and G. S. Burden (*J. econ. Ent.*, 1954, **47,** 501—506).—Two hundred and three compounds were tested in the laboratory as synergists for allethrin against *Pediculus humanus humanus*, L. On a residue basis, both as cloth impregnants and in powders, the following nine materials were equal to or slightly more effective than was sulphoxide:—1 : 2-methylenedioxy-4-[2-(octanesulphonyl)-propyl]benzene, dibutylpiperonylidene ester of malonic acid, and the following esters of chrysanthemumic acid: α-allylpiperonyl, α-amylpiperonyl, α-butylpiperonyl, α-butylpiperonyl, α-ethyl-*tert.* piperonyl, α-(2-methylallyl)piperonyl, and 4-(3 : 4-methylenedioxyphenyl)-*sec.*-butyl. A. A. MARSDEN.

Louse powder synergists. G. W. Eddy, M. M. Cole, and A. S. Marulli (*Soap, N.Y.*, 1954, **30,** No. 7, 121—123, 143, 145).—Twenty-two listed compounds were tested as synergists for the following P compounds toxic to lice: 4-methylumbelliferone *OO*-diethyl dithiophosphate (Potasan), 3-chloro-4-methylumbelliferone *OO*-diethyl dithiophosphate (Bayer compound 21/199) and the corresponding *OO*-dimethyl dithiophosphate (Bayer compound 21/200). Beaker tests and cloth impregnation tests showed that most of the synergists increased the insecticidal activity of the P compounds, some as much as tenfold. The residual effectiveness was also increased. No one synergist was the most effective with all the P compounds; but the best over-all results were with 1 : 2-methylenedioxy-4-[2-(octanesulphonyl)propyl]benzene and the corresponding sulphinyl compound. The two synergists were ineffective with the P compounds Parathion, Malathion, and EPN. G. HELMS.

Bait studies for fly control. G. S. Langford, W. T. Johnson, and W. C. Harding (*J. econ. Ent.*, 1954, **47,** 438—441).—Of 27 chemicals tested as house-fly baits, three org. phosphates: Malathion, Diazinon, and a dialkyl phosphate (Bayer's L 13/59) were highly effective for killing flies in a 12·5% of sugar solution. Chlorinated hydrocarbon baits effectively controlled non-resistant flies in the laboratory, but were unsatisfactory in the field. CS-708 gave fair control, but borax, $CuSO_4$, formalin, NaF, and rotenone were relatively ineffective. A. A. MARSDEN.

Toxicology of disinfectants. L. C. Barail (*Soap, N,Y.*, 1954, **38,** No. 8, 149—151, 158—159, 161, 163).—Disinfectants and sanitisers fall into five main groups, viz., chemical specialities based on alkalis such as caustic soda, sodium carbonate, phosphate in conjunction with perborate, abrasives, and soapless detergents; pine oil type disinfectants; quaternary ammonium compounds; chlorine derivates, *e.g.*, hypochlorite; and cresol and phenol derivatives. The broad toxicological properties of the five groups, and of deodorants and masking agents are discussed. G. HELMS.

Rapid determination of calcium and magnesium in sea-water. A. de Sousa (*Anal. chim. Acta*, 1954, **11,** 221—224).—The sample is made alkaline (pH slightly above 12) with NaOH, saturated murexide is added, and the Ca determined by titration with 0·1M-Na_2 ethylenediaminetetra-acetate (EDTA). A further sample is mixed with 10 ml. of a buffer solution containing 54 g. of NH_4Cl and 350 ml. of aq. NH_3 (25%) in 1 litre, Eriochrome Black T indicator is added, and the solution heated to 40—50°. Titration with the EDTA solution gives Ca + Mg, Mg being obtained by difference. W. C. JOHNSON.

Water works practices. Design criteria. I, II. G. E. Symons (*Wat. & Sewage Wks*, 1954, **101,** 222—226, 266—270).—I. The estimate of the desired capacity of a new water works should consider changes in *per capita* requirements during the anticipated life of the installation. Population changes and industrial changes must also be predicted. Certain data are given for this purpose.

II. The design criteria for a number of aspects of water supply are quoted in general terms. These are source of supply, treatment pressure requirements, pumping equipment, distribution. J.A.C. ABSTR.

Problems of small water systems and how they can be solved. J. A. Dietrick (*Wat. & Sewage Wks*, 1954, **101,** 271—274).—In the case of small water systems, location of faults is important and mechanical fault-finding devices are extremely useful. The problems of a small water works are briefly discussed. J.A.C. ABSTR.

Maintaining well production by chemical cleaning. G. L. E. Linn (*J. Amer. Wat. Wks Ass.*, 1954, **46,** 534—540).—Results are quoted of the use of H_2SO_4 and HCl, both inhibited with phosphates, in the cleaning of wells, and a mechanical device for cleaning pipelines is described. J.A.C. ABSTR.

Multiple water treatment units—a continuing experience report. E. H. Aldrich (*Wat. & Sewage Wks*, 1954, **101,** 249—253).—Several installations using multiple water-treatment units are described with diagrams. One case is described where automatic filter control is used for satisfactory operation. A chart is given showing construction cost figures for conventional filters and purification units, showing the latter to be cheaper to set up. J.A.C. ABSTR.

Sulphuric acid regeneration of high-capacity cation-exchanger [for water]. John H. Kay, J. I. Bregman, A. M. Fradkin, and J. S. D'Amico (*Industr. Engng Chem.*, 1954, **46,** 862—866).—An investigation of the factors governing the use of H_2SO_4 as a regenerant for high-capacity cation-exchangers and the development of better regeneration techniques having optimum capacity, efficiency, and water quality are described. Several methods employing higher acid concentrations, the results of their application, and their advantages and disadvantages are discussed. Important factors affecting acid regeneration are reviewed, with particular reference to the characteristics of the exhaustant to be treated. J.A.C. ABSTR.

Industrial wastes. Sheppard T. Powell (*Industr. Engng Chem.*, 1954, **46,** No. 5, 97A—99A).—Acid wastes, created by coal and ash piles and from other sources, wastes from water softening and demineralisation treating systems, and hot water pollutant in surface and ground water supplies are discussed. J.A.C. ABSTR.

1953 industrial wastes forum. D. E. Bloodgood *et al.* (*Sewage industr. Wastes*, 1954, **26,** 640—655).—A symposium on the general principles of stream pollution abatement is reported. The topics discussed include the criteria to be used in assessing the value of a stream for waste disposal and dilution factors for stream disposal of industrial wastes. J.A.C. ABSTR.

Decontamination of radioactively contaminated water by slurrying with clay. W. J. Lacy (*Industr. Engng Chem.*, 1954, **46,** 1061—1065).—A study of the use of clay for decontaminating radioactively polluted water is reported. Results show that clay is particularly effective for removing ^{141}Ce–^{144}Ce–^{144}Pr, ^{95}Zr–^{95}Nb, ^{140}Ba–^{140}La,

and ^{90}Sr–^{90}Y, less effective for ^{106}Ru–^{106}Rh, and very poor for ^{131}I. A clay dosage of 1000 p.p.m. appears to be adequate, increased dosages being wasteful. Varying the Ca ion concn. from 0 to 200 p.p.m. has little or no effect on the removal of mixed fission products. Elevated pH (over 5) favours removal of mixed fission products. Effectiveness of coagulation and filtration in removing dissolved radioactive contaminants can be improved by preliminary slurrying with clay or by adding clay directly to the water during coagulation along with the coagulating chemicals. J.A.C. ABSTR.

Disposal of toxic industrial waste. Some methods for cyanide used in the United States. Francis J. Knight (*Metallurgia, Manchr*, 1954, **49**, 279—280).—Measures for dealing with spillage from cyanide baths and rinse tanks, flow from chemical storage tanks, etc., are detailed, and the following methods of neutralising cyanide-containing waste are outlined: (1) conversion to volatile HCN, by the addition of H_2SO_4 (suitable for factories not in a built-up area); (2) oxidation to CNO′, using NaCl or Cl_2 (readily applied to heavily cyanided residues from plating baths); and (3) oxidation by $Ca(OCl)_2$ (suitable for all but the most concentrated cyanide mixtures). J.A.C. ABSTR.

Treatment of rouge wastes. J. A. McCarthy (*Sanitalk*, 1953, **2**, No. 1, 8—9, 20).—Waste waters from the manufacture of optical glass have a low B.O.D. but contain large quantities of finely divided iron and glass. With detergents present these materials form a very turbid and highly coloured mixture. $CaCl_2$ added to give ~250 p.p.m. in the waste waters reduced the colour from 900 to 35 units, the concn. of iron from 28 to 1·2 p.p.m., total suspended solids from 1080 to 3 p.p.m., and alkalinity from 52 to 4 p.p.m. A more conc. waste water having a colour of 5000 units and containing as much as 1000 p.p.m. iron was best coagulated by adding 75—100 p.p.m. of lime and 600 p.p.m. of $CaCl_2$. The sludge settled rapidly and was not bulky. The supernatant liquid was clear, practically free from caustic alkalinity, and contained 2·3 p.p.m. of Fe. Recovery of rouge from the sludge was not economical. WAT. POLLUT. ABSTR. (J.A.C. ABSTR.).

Pipe mill waste water treatment. M. G. Van Voorhis (*Wat. & Sewage Wks*, 1954, **101**, 242—244).—An installation is described for purifying an industrial effluent from a seamless metal tubing factory containing oil and grease with much solid matter. The use of Raschig rings in the settling tanks is claimed to assist the settling. J.A.C. ABSTR.

Phenolic waste problem in the U.S.A. and how it is being handled. N. S. Chamberlin and A. E. Griffin (*Munic. Util.*, 1953, **91**, No. 11, 49—50, 80—87).—At gas works and cokeworks, ammoniacal liquor is usually treated by the Koppers process involving steam stripping and absorption of the phenol in NaOH before NH_3 is removed. Effluent from the NH_3 still is generally used for coke-quenching. In works manufacturing phenol or using it as a raw material, the phenol is usually removed from the waste waters by solvent extraction. One plant successfully uses the coal-absorption method in which the waste waters are treated with powdered coal at pH 6·5; the slurry is transferred to tanks, where the coal plus organic material is removed by flotation and then filtered, dried, and used as fuel. Residual phenol can be removed from treated waste waters by biological oxidation either in percolating filters or by the activated-sludge process. Oxidation with ClO_2 is used for waste waters low in phenol or to remove traces of phenols in effluents from biological oxidation units. WAT. POLLUT. ABSTR. (J.A.C. ABSTR.).

Canadian experiences in dealing with phenolic wastes. A. D. McRae (*Munic. Util.*, 1953, **91**, No. 11, 51—53, 77—80).—Methods of disposal of phenolic waste waters in Canada are discussed in relation to prevention of pollution of boundary waters between the U.S. and Canada. Phenols are generally removed by absorption on activated carbon, extraction with solvents, or volatilisation. At one small chemical works, 10,000 gal. of waste waters containing 350 p.p.m. of chlorophenol are treated daily by oxidation with chlorine; NaOH is added to maintain a pH of 9—11 during treatment. In the petroleum industry, phenolic waste waters from steam stripping are vaporised and the phenol is absorbed in oil, floor drainage is disposed of in furnaces, spent NaOH solution from the washing of petroleum distillates is neutralised to remove phenols with acid oils and the mixture is used as fuel, and waste waters from the catalytic cracking plant are treated by spraying into the catalyst-regenerating section of the cracking plant at 1100°F., when the phenols and H_2S are decomposed. If necessary, the aq. phase of neutralised caustic lye may be treated by biological oxidation. WAT. POLLUT. ABSTR. (J.A.C. ABSTR.).

Paper and pulp waste reduction by mill improvement. R. M. Drummond (*Sewage industr. Wastes*, 1954, **26**, 656—660).—Improvement in the operation of a paper mill (*e.g.*, re-use of "white water," and more efficient recovery of Na_2CO_3 by burning the "black liquor" from the pulp cookers) have greatly reduced the discharge of waste to the Niagara river and brought about an economy of raw materials. J.A.C. ABSTR.

Chemical and biological studies on flax wastes stabilisation. W. H. Oldaker (*Sanitalk*, 1953, **2**, No. 1, 15—20).—Experiments were made on the treatment of black liquor from preliminary treatment of flax fibres for preparation of speciality paper. Waste waters consisting of spent cooking liquor and wash and rinse water are discharged at a rate of 30,000 gal. per day by one mill of which 13,000 gal. is spent black liquor. The 5-day B.O.D. of the liquor discharged ranged from 30,000—40,000 p.p.m. The liquor contained 13—14% of solids and 0·3—0·5% of NaOH. Treatment by addition of acid for neutralisation and by coagulation with alum, $CaCl_2$, or $FeCl_3$, proved impractical as large amounts of sludge were produced and the max. reduction of B.O.D. was only 50%. By diluting the waste waters to 1% with river water, it was possible to treat them by biological filtration. The percolating filters were acclimatised to the waste waters which were applied at a rate of 5 gal. of the conc. waste per day and with a B.O.D. loading of about 500 lb. per acre-ft. per day. Treatment reduced the pH from 7·9—9·8 to 7·6—8·3 and the B.O.D. by 57—72%. The filters became more efficient with regard to B.O.D. removal with time; after 35 days' operation the filters were about 15% more efficient. WAT. POLLUT. ABSTR. (J.A.C. ABSTR.).

Scientific basis for liming of digesters. C. N. Sawyer, F. S. Howard, and E. R. Pershe (*Sewage industr. Wastes*, 1954, **26**, 935—944).—The addition of lime is a suitable practical means of relieving "stuck" digesters. The theoretical quantity of lime required is that needed to combine completely with the volatile acids present, but this amount can be increased to over 200%, and a more satisfactory result is likely to be obtained. The addition of this lime in large batches has no deleterious effect on the operation. A. WEBSTER.

Animal parasites in sewage and irrigation water. Wen-Lan Lou Wang and S. G. Dunlop (*Sewage industr. Wastes*, 1954, **26**, 1020—1032).—Primary sewage treatment plus chlorination removes certain animal parasites. Coliform organisms and enterococci have been removed to the extent of 99%, but *Ascaris* ova and *End. coli* cysts have not been removed to anything like this extent. Definite conclusions as to the significance of these findings are not given, as the minimum infecting doses of the organisms mentioned are not yet known. A. WEBSTER.

Determination of synthetic detergents in sewage. G. P. Edwards and M. E. Ginn (*Sewage industr. Wastes*, 1954, **26**, 945—953).—At least 90% of synthetic detergents used in the United States are of the anion-active type and are alkylarylsulphonates. The Lewis and Herndon modification (*ibid.*, 1952, **24**, 1456) of Barr's method has proved satisfactory for determination of these detergents. It was found that better separation of the emulsion took place with a solvent lighter than water, and commercial hexane was selected. The pH is kept constant between 7·0 and 7·5 by the use of a phosphate–Na_2H_2 ethylenediaminetetra-acetate buffer, which avoids errors caused by the presence of Ca and Mg salts. Bromophenol blue or Azo phloxine can be used as the indicating dyestuff. Full instructions for the method are given. A. WEBSTER.

Activated sludge treatment. D. E. Bloodgood (*Wat. & Sewage Wks*, 1954, **101**, 288—291).—A general description of the operation of the activated sludge process with illustrations of a number of plants. Suggestions are made for the best method of starting up a new plant. J.A.C. ABSTR.

Measurement of oxygen uptake by oxidation-reduction potential. J. P. Horton (*Instruments and Automation*, 1954, **27**, 1312—1313).—The rate of metabolism of bacteria in an activated-sludge system can be determined from potentiometric measurements of redox potential (V_r) in samples of liquor in a sealed Erlenmeyer flask. The simple apparatus and procedure used at dairy-waste disposal plants of the activated-sludge type is described. By plotting rate of change of V_r against time, hourly variations in metabolic activity can be followed and the process can be strictly controlled. Temp. and pH of the samples are also recorded. W. J. BAKER.

Radon in sewage outfall studies. T. G. Bullen and W. F. O'Connor (*Sewage industr. Wastes*, 1954, **26**, 627—634).—The radon content of the raw sewage was found to be 10- to 50-fold greater than that of natural waters in Westchester County, U.S.A. and this phenomenon (which is the result of radon from the decay of Ra compounds in the soil being washed into the sewers by rain) was employed to trace sewage in the neighbourhood of the outfalls and estimate the initial dilution. If the more sensitive electrometer system devised by Hess (*Trans. Amer. geophys. Union*, Pt. II, Hydrology, 1943, 587) were employed the technique would enable tidal effects on sewage disposal, and infiltration into sewers, to be studied. J.A.C. ABSTR.

Determination of polycyclic hydrocarbons in town air. R. L. Cooper (*Analyst*, 1954, **79**, 573—579).—Suspended matter in a measured vol. of air is collected daily by aspiration through filter paper, the wt. of deposit being ascertained by means of a calibrated reflectometer. The papers are extracted with acetone, the extracted material is transferred into *cyclo*hexane which is then poured on to an Al_2O_3 chromatograph column and developed with *cyclo*hexane. During development the eluates are examined spectrophotometrically at the peak wavelengths corresponding to individual hydrocarbons and, after suitable combinations of the eluate fractions, the hydrocarbons are determined spectrophotometrically. The results are considered in relation to the recent increase in lung cancer as the carcinogen 3 : 4-benzpyrene is present in atmospheric smoke. A. O. JONES.

Fumigating apparatus. Deodor-X Hygiene Services, Ltd. (Inventor: Richard Morgan) (B.P. 711,474, 7.12.50).—To provide a safer method of handling cyanide fumigants a portable storage container is used which is fitted with self-sealing valves which automatically open on the attachment of a hose. J. W. MULLIN.

Process for drying foul slime [*e.g.*, activated sludge]. L. von Roll A.-G. (B.P. 709,131, 31.7.51. Switz., 14.8.50).—The plant consists of a preheater, evaporator, and a plate drier. The sludge is fed from a storage container by a sludge pump to these units in turn. The vapours formed in the evaporator are fed to a compressor and then forced, as heating media, into the plates of the drier and also into the evaporator. Vapours from the plate drier are similarly used after passing through a washer. Part of the condensate from the evaporator is fed to the preheater and then used as cooling medium and lubricant to the stuffing boxes of the compressor. The sludge is moved about by rotating rakes in all three units and is divided into rodlets at one stage in the drier to prevent large lumps conglomerating. Drying of the rodlets then proceeds. J.A.C. ABSTR.

4.—APPARATUS AND UNCLASSIFIED

Semi-micro Orsat gas analyser. John J. McMullen and Otto J. Stark (*J. Ass. off. agric. Chem., Wash.*, 1954, **37**, 856—860).—The apparatus described and illustrated is suitable for the determination of O_2 and CO_2 in 1—10 ml. of headspace gas above packed milk powder, with an accuracy of $\pm$ 0·2%. The gas burette is of Van Slyke type. A. A. ELDRIDGE.

One-step digestion procedure for the estimation of total phosphorus and nitrogen in mould tissue. S. P. Damle and P. S. Krishnan (*Anal. chim. Acta*, 1954, **11**, 225—228).—The residue obtained on digestion of tissue with H_2SO_4 and H_2O_2, which is obtained in the determination of total P, can also be used for determination of N. The procedure is given in detail, and is applied to determination of total N in moulds, in acetonised liver groundnut cake, and in acetonised *B. cadaveris*. The results show fair to good agreement with those obtained when Se, $CuSO_4$, and K_2SO_4 are used to catalyse the oxidation. The latter method requires a longer digestion time (8 to 10 hr.). W. C. JOHNSON.

Particle size measurements by light scattering. R. O. Gumprecht (*Dissert. Abstr.*, 1954, **14**, 646—647).—Light scattering is a feasible means of determining particle size and distribution in atomic sprays. The Lambert/Beer transmission equation must be corrected for the optical geometry of transmitted light measuring system. This correction may be predicted from the Mie or, preferably, classical diffraction theory. J.A.C. ABSTR.

New technique for counting lyophobic particles in a hydrosol. A. Watillou and F. Van Grunderbeeck (*Bull. Soc. chim. Belg.*, 1954, **63**, 115—132).—The classical method of counting hydrophobic particles in a sol. by means of a slit ultramicroscope can be used for accurate measurement of particle concn. It is necessary to extrapolate to infinite aperture the apparent particle concn. measured at different slit apertures. A more accurate and more rapid method is described in which a known vol. of sol. sufficiently large for concn. fluctuations to be negligible is caused to stream through the field of view so that all particles in it can be counted. Results obtained by this method for a no. of Se hydrosols are in excellent agreement (within 5%) with measurements obtained by the extension of the classical method and by electron microscopy. J.A.C. ABSTR.

Refraction methods of studying concentration gradients. T. J. Bowen (*Lab. Practice*, 1954, **3**, 233—237).—The use of refraction methods in the study of solute mol. and the optical systems involved, the Schlieren scanning method, and a modification of this using a cylindrical lens, are reviewed. J.A.C. ABSTR.

A quantitative laboratory grinding apparatus for small samples. A. Dangoumau (*Chim. anal.*, 1954, **36**, 179—181).—A grinding or homogenising apparatus, depending on vigorous vertical reciprocating motion of the sample (1—5 g.) with 18 : 8 stainless steel balls is described. A jacket allows variation of grinding temp. J.A.C. ABSTR.

Effects of strong radio-frequency fields on micro-organisms in aqueous solutions. G. H. Brown and W. C. Morrison (*Food Technol.*, 1954, **8**, 361—366).—A series of experiments was made using a wide range of frequencies to treat specimens which varied widely in conductivity. The electric field intensities and temp. rise were studied. The results are discussed and summarised. No significant destruction of bacteria in aq. solution occurs from the application of radio-frequency fields in the frequency range up to 600 mega-cycles excepting the destruction brought about by thermal effects. E. M. J.

Automatic device for starting paper chromatograms. L. J. B. Husband (*Chem. & Ind.*, 1954, 776—777).—An automatic device is described and sketched to start chromatograms by bringing solvent into contact with the prepared filter paper at a pre-determined time during the night so that the chromatograms are ready for examination in the morning. Equilibration of solvent and vapour is established during a period of about 6 hr. before the solvent is allowed to run into the prepared, empty trough, which takes place without any disturbance of the vapour equilibrium. J.A.C. ABSTR.

An apparatus for paper partition chromatography. Margaret Alcock and J. S. Cannell (*Analyst*, 1954, **79**, 389—391).—An apparatus is described and illustrated in which some of the disadvantages of paper-partition chromatography are overcome. The apparatus cannot be used for elution chromatography. Its advantages are its small size (6·9 × 4·9 × 5·8 in.) and the rapid attainment of equilibrium between solvent and internal atmosphere and between the metal and its surroundings. It may thus be used in refrigerator, incubator, or low-temp. oven. It has been used particularly for the investigation of variation of R_F with temp. in sugar solutions. J.A.C. ABSTR.

Continuous scanning device for paper electrophoresis and strip chromatography. O. Bassir (*Chem. & Ind.*, 1954, 709—710).—Details are given for the construction of a simple photoelectric scanning device for use in micro-electrophoretic techniques, using a small rotating drum and a 6 v., 18 amp. light source with a suspended mirror galvanometer. J.A.C. ABSTR.

Mercurimetric determination of chlorides. J. Ungar (*Chem. & Ind.*, 1954, 787).—The mercurimetric determination of chlorides (J.S.F.A. Abstr. 1954, ii, 104) is modified for use in water analysis. When $Hg(NO_3)_2$ is prepared in 1·0N-HNO_3, instead of in water containing 20 ml. of 2N-HNO_3, accurate results are obtained when using a 100-ml. sample of water and 5 ml. of diphenylcarbazone indicator (0·1 g. per 100 ml. of alcohol). The chloride content of acid solutions (*e.g.*, dil. HCl) can be determined by this method. The lower pH limit of the method can be varied by lowering the pH value of the $Hg(NO_3)_2$ titrating solution. J.A.C. ABSTR.

Mercuric determination of chlorides. Edward G. Hill (*Chem. & Ind.*, 1954, 852—853).—The method proposed by Ungar (cf. preceding abstract) for determining chlorides by titration with mercuric nitrate has been investigated with the pH of the solution varied with different amounts of buffer solution developed by Thiel *et al.* (cf. *Z. Elektrochemie*, 1934, **40**, 150). The colour intensity varied widely over the range pH 4·0—6·0 and above pH 7·5 the solution became more and more red with increasing alkalinity. J.A.C. ABSTR.

Colorimetric determination of traces of boron by carmine. R. Cypres and P. Leherte (*Bull. Soc. chim. Belg.*, 1954, **63**, 101—114).—A detailed investigation is reported of a colorimetric method for the determination of quantities of B of the order of 0·05—50 μg. The method obviates the necessity for a preliminary separation of the B, *e.g.*, by distillation of Me borate. The factors investigated include variation of optical density with wavelength and time, the concn. range over which the Beer–Lambert law holds, carmine concn., effect of added HCl and of H_2SO_4 concn. For the determination of B in solution, 2 ml. of the solution are treated with cooling with ~10 ml. of 95—97% H_2SO_4 (*d* 1·84) and 10 ml. of the dye solution (0·05 $\pm$ 0·01% in 95—97% H_2SO_4) are added and the vol. brought to 25 ml. with 95—97% H_2SO_4. After 45 min. the absorption at 610 mμ. is compared with that of a control sample. Detailed methods for the determination of traces of B in Ca, C, and U_3O_8 are also described. Since the optical density of the complex increases with increasing H_2SO_4 concn. the error can be reduced from $\pm$ 0·05 μg. to $\pm$ 0·02 μg. by elimination of H_2O. The use of oleum has not proved satisfactory as yet. J.A.C. ABSTR.

SOCIETY OF CHEMICAL INDUSTRY

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Printed in Great Britain by Butler & Tanner Ltd., Frome and London

J. Sci. Food Agric., 6, January, 1955

JOURNAL OF THE SCIENCE OF FOOD AND AGRICULTURE

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